

THE EVALUATION OF PARTICIPATORY APPROACHES TO LIVESTOCK
PRODUCTION RESEARCH

FINAL TECHNICAL REPORT

LIVESTOCK PRODUCTION PROGRAMME PROJECT No. R6776

Edited by John Morton

with contributions from: Danni Romney, Steve Ashley, Ben Lukuyu, Rob
Paterson, Sabine Gündel, Sarah Holden, Nicholas Massawe, Louis Mtenga,
Emyr Owen

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CONTENTS

- A. Project Completion Summary Sheet
- B. Final Technical Report
- C. MORTON, J, “Participatory Livestock Production Research in Kenya and Tanzania – Experiences and Issues”
- D. MORTON, J. and ROMNEY, D.L. “A Note on Participatory Aspects of NRI/KARI/ILRI Research on Farmer Feeding Strategies”
- E. LUKUYU, B.A., PATERSON, R.T., ROMNEY, D.L. and GÜNDEL, S. “A Case Study of Participatory Research into Fodder Production from Maize in Kenya”
- F. PATERSON, R.T, “Some Reflections on Participatory Research, with Particular Reference to A Case Study of Participatory Research into Fodder Production from Maize in Kenya”
- G. ASHLEY, S.D., HOLDEN, S.J., MASSAWE, N.F., OWEN, E., MTENGA, L., and ROMNEY, D.L. “Compromise and Challenges: the process of Participatory Livestock research in Tanzania”

FINAL TECHNICAL REPORT: EVALUATION OF FARMER- PARTICIPATORY APPROACHES TO LIVESTOCK PRODUCTION RESEARCH - R6776 (A0646)

Executive Summary

This project was designed to enable the exchange of experience between researchers involved in two DFID-funded livestock research projects (R6619 and R6775) that have attempted to take participatory approaches to livestock production research, and a broader collation of experience and views from researchers, research managers and development staff involved in livestock research in Kenya and Tanzania. The project funded a series of meetings, including a major workshop in Arusha, Tanzania, visits to livestock research and development projects in both countries, and papers highlighting participatory issues in both linked projects. While the research recognised that there was far less experience in applying participatory methodologies to livestock rather than crop research, neither of the linked projects was able, for different reasons, to provide an example of participatory on-farm livestock trials. Instead, the research and networking highlighted institutional issues largely (but not entirely) shared with participatory crop research. The current report introduces an overview paper reviewing participatory issues raised, and case studies from the two linked projects.

Background

1. This project was designed to enable the exchange of experience between researchers involved in two DFID-funded livestock research projects that have attempted to take participatory approaches to livestock production research, and a broader collation of experience and views from researchers, research managers and development staff involved in livestock research in Kenya and Tanzania.
2. DFID's Livestock Production Research Programme (LPP) funded research by Reading University, in collaboration with Sokoine University of Agriculture, Livestock in Development and NRI on "Husbandry strategies for improving the sustainable utilisation of forages to increase profitable milk production from cows and goats on smallholder farms in Tanzania" (R6619). This project identified problems and opportunities in the semi-arid area of Sukumaland, and the higher potential areas of Kilimanjaro and Mgeta, and went on to investigate improvements in the management of feed in Kilimanjaro. LPP has also funded research by NRI, in collaboration with the Kenyan Agricultural Research Institute and ILRI on "Evaluation and improvement of feeding strategies for optimising feed intake in crop/livestock systems" (R6775), which took place among small-scale dairy producers in Kiambu District, adjacent to Nairobi. Because the two projects shared a participatory approach and a concern with dairy systems in relatively high potential areas, and because it is felt that participatory research methodologies are less well developed for livestock production than for research, the LPP also gave modest funding for the present "Link Project" to allow researchers on both projects to exchange experiences and to network with other research and development projects promoting a participatory approach to livestock production research in East Africa. The project was conceived and led by Dr Danni Romney of NRI until her move to ILRI in 1999, and by Dr John Morton of NRI thereafter.

Project Purpose

3. The project purpose consisted of the then LPP output 1.4 for High Potential Systems: "Improved strategies for animal husbandry and nutrition in intensive livestock production systems and in crop/livestock systems in high potential and peri-urban areas developed and promoted".
4. Its outputs were:
 - Improved methodologies for farmer participation developed through inter-project exchange, and
 - Documentation of farmer-participatory research methodologies which can be used in a livestock production context.

Research Activities

5. The project started by funding a visit by Mr Massawe of the Tanzanian project to ILRI in late 1996, followed by a meeting between Mr Massawe and UK-based researchers on both linked projects in Reading in early 1997. A major workshop in Arusha, Tanzania in April 1997, assembled all the researchers associated with the two projects, plus a number of other Tanzanian and Kenyan livestock researchers, a total of 15 people. Following a field visit for all participants to smallholder dairy farms in the Kilimanjaro Region led by Mr Massawe, there was a day of discussion in Arusha, in which both the main projects, and some others, such as a KARI project on maize as fodder and a the Netherlands-funded Lake Zone Farming Systems Research Project in Tanzania, made presentations. There was discussion on suitable methodologies at various points in the project cycle, and for possible reasons for the underdevelopment of participatory methodologies in livestock research, but a lot of discussion focussed on the institutional contexts for participatory research in general: donor expectations and funding cycles, the requirements of Ph.D.s, the difficulty of publishing participatory research and its effects on career progression within NARS.

6. After the workshop, Dr Morton, the NRI social anthropologist associated with the current project and with R6775, made a brief tour of some research and development organisations involved with livestock research in Tanzania. These included:

- Heifer Project International Tanzania Office in Arusha
- Former staff of the FAO Mount Kilimanjaro Project
- Tanga Dairy Development Project (Netherlands-funded)
- Tanga Livestock Research Project
- Staff of various departments of Sokoine Agricultural University

7. A paper based on, but taking further, issues that arose in the workshop and during the subsequent visit was written (Morton et al. 1997) and circulated to all participants and others in the region. Attempts were made to network further with Tanzanian organisations by fax and email, but this received a limited response.

8. In January 1998, because a number of the researchers associated with both projects were present in Nairobi in connection with the BSAS Conference on "People, Lands and Livelihoods: setting research agendas for animal science", it was decided to hold a short workshop at KARI-Muguga. This was attended by 20 researchers from Kenya, Tanzania and UK. Presentations were made by Mr Massawe on R6619, by Ben Lukuyu on the longitudinal monitoring component of R6775, and by BSJ Msangi on a third project,

“Development of feeding strategies to improve reproductive performance and milk yields of cows in high potential, mixed farming systems” (NRI/LRC Tanga/Reading University - R6359). Discussion centred on the difficulties of capturing seasonality in PRA, the role of longitudinal monitoring within participatory research, and the need for further discussion of participatory on-farm trials with livestock.

9. In October-November 1998 Dr Morton visited research and development organisations involved with livestock research in Kenya. These included:

- National Dairy Cattle and Poultry Research Project (Netherlands-funded)
- GTZ Integrated Small Livestock Project
- Regional Land Management Unit (Swedish-funded)
- ICRAF
- KARI-Kitale and KARI-Kisii

10. Some valuable insights, and literature, was obtained from these visits, and from subsequent postal contacts with the Finnish-funded Livestock Development Project in Kisumu, and contact with Dr Paterson of NRI, formerly stationed at KARI-Embu. Again, some other attempts to follow up contacts at a distance were less successful. The visits to KARI were made in the company of Mike Scarr of the DFID-KAR NARP II Project and Dr Romney in her role as backstop to that project. Dr Morton was able to participate in discussions on the future of research projects, rather than interviewing researchers on methodology post-hoc, which gave additional insights into the issues involved in making the projects more participatory.

11. During 1999 there was minor activity in reviewing grey literature obtained. In 2000 papers were commissioned that explored the issues for participatory research raised by the two linked projects. Ashley et al. (this volume) considers the experience of Project R6619 under the title of "Compromise and Challenges". This project proceeded largely as planned, but had greater difficulty than anticipated in combining participatory objectives with the production of new scientific knowledge. They discuss the institutional issues, such as Ph.D. requirements and professional reward systems, that constrain participatory research, but also raise more far-reaching questions about whether animal production science *per se* can respond to the multiple needs of poor livestock keepers.

12. Project R6775 had proceeded in a less straightforward manner, again needing to compromise between participatory, scientific and institutional objectives. Participatory feeding trials did not take place, but as a late addition to project design, participatory agronomic trials (on maize as a fodder) did. Morton and Romney (this volume) is a brief note on participatory aspects of the project up to the decision to include agronomic

trials, while participatory issues surrounding those trials are discussed by Lukuyu et al. (this volume). One of the authors of the paper, who had not been involved in the research but had reviewed the materials and had previously been involved in similar research in Kenya, came to slightly different conclusions, or at least a different emphasis, regarding the implications for participatory livestock research. His comments are included separately (Paterson, this volume). We believe this difference in views is not a weakness in the project, as it might be in conventional scientific research, but a healthy plurality of opinion. It is a reminder that there can be no right and wrong in the field of participatory research, which is a social activity and inevitably subject to multiple interpretations.

13. An overarching “issues paper” (Morton, this volume) combines insights from the case studies, the workshops, discussions with other projects in Kenya and Tanzania and the literature.

Outputs

14. The project envisaged two sorts of output. One was that as a result of networking facilitated by the Link Project, improved methodologies were adopted by the two linked projects. We feel that this was met, particularly as concerns R6619, where Mr Massawe was supported in his attempts to combine participatory and scientific concerns. More broadly, the project has helped to keep participatory livestock research on the agenda in Kenya and Tanzania, and created links between Kenyan and Tanzanian researchers who would otherwise have little contact.

15. As regards the second form of output, documentation, apart from internal back-to-office and workshop reports, there were two outputs during the course of the project:

- MORTON, J., ASHLEY S., ROMNEY, D. and MTENGA, L. (1998) “Farmer Participatory Research in Livestock Production: Themes from a Workshop in Arusha”

This paper was circulated informally to those attending the Arusha and Muguga workshops

- MORTON, J., KEENGWE, M., KONDE, A., CURRY, J. and MBUGUA, D. (1998) "How Can Participation Contribute to Effective Research Agendas?" in M. Gill, T. Smith, G.E. Pollott, E. Owen and T.L.J. Lawrence (eds.) *Food Lands and Livelihoods - setting research agendas for animal science*, British Society of Animal Science Occasional Publication No. 21, Edinburgh.

Issues arising during the project formed a major part of the discussion in the working group on "How can participation contribute to effective

research agendas" at the 1998 BSAS Nairobi conference, and one of the project staff acted as rapporteur for the group and discussant for the final plenary session.

16. Other outputs are included as unpublished papers in the present volume:

- MORTON, J, "Participatory Livestock Production Research in Kenya and Tanzania – Experiences and Issues"
- ASHLEY, S.D., HOLDEN, S.J., MASSAWE, N.F., OWEN, E., MTENGA, L., and ROMNEY, D.L. "Compromise and Challenges: the process of Participatory Livestock research in Tanzania"
- MORTON, J. and ROMNEY, D.L. "A Note on Participatory Aspects of NRI/KARI/ILRI Research on Farmer Feeding Strategies"
- LUKUYU, B.A., PATERSON, R.T., ROMNEY, D.L. and GÜNDEL, S. "A Case Study of Participatory Research into Fodder Production from Maize in Kenya"
- PATERSON, R.T, "Some Reflections on Participatory Research, with Particular Reference to A Case Study of Participatory Research into Fodder Production from Maize in Kenya"

17. The first of the above-mentioned outputs makes a number of concluding remarks:

- Clarity of objectives has been a constant theme in the research. Not all research can, or should be, highly participatory: what is important is to match methodologies to objectives. For much research, particularly funded by research budgets, this is likely to mean nudging research slightly from a consultative towards a collaborative mode.
- There are important reasons why participatory methodologies are less developed for livestock research, and these must be understood.
- However, many of the most important constraints to participatory research are institutional, are shared with participatory research in any sub-sector, but also vary greatly between the institutional hosts of research and the funding sources.
- Because of the circumstances of the two linked projects, this project was not able to say a great deal about participatory livestock trials. There therefore remains important work to be done in reflecting further on analytical techniques that can be used with participatory data, and most importantly in documenting participatory methodologies for on-farm livestock trials from around the world.

18. A final decision will be taken on disseminating the papers in the current volume in the light of the dissemination plans of R6775, and peer review by LPP.

Contribution of Outputs

18. As discussed above, we feel the relatively modest investment in this project has added value to the linked projects, and stimulated discussion and networking on participatory livestock research within and between Kenya and Tanzania. Because of internal developments within Project R6775, the Link project has not been able to document practical experience in participatory feeding trials as it would otherwise have done, but it has re-directed attention to broader questions of the institutional contexts for participatory livestock research, and the problems of meeting institutionally-reinforced scientific objectives while addressing the real-world problems of poor livestock keepers.

PARTICIPATORY LIVESTOCK PRODUCTION RESEARCH IN KENYA AND TANZANIA - EXPERIENCES AND ISSUES

John Morton¹

Introduction

The DFID-funded research project entitled "Evaluation of Farmer-Participatory Approaches to Livestock Production Research", or simply the "Link Project" was designed to complement two DFID-funded livestock research projects in Kenya and Tanzania that have attempted to take participatory approaches to livestock production research. The Link project funded two workshops to enable the exchange of experience between researchers involved in the projects and other colleagues from Tanzania and Kenya. As the linked projects ended, researchers associated with each of them have been able to reflect on the issues raised for participatory research in livestock production (Ashley *et al.* 2000, Lukuyu *et al.* 2001). The project also allowed a broader collation of experience and views from researchers, research managers and development staff involved in livestock research in Kenya and Tanzania.

This paper provides an overview of the issues raised during these activities. It does not aim to be a manual for participatory research in livestock production. Materials are increasingly appearing that can advise researchers on the conduct of participatory research (in a general agricultural rather than specifically livestock context) (see especially Sutherland 1998, Conroy *et al.* 1999 and Sutherland and Martin 1999) and there are also sources that deal with the "PRA tools" suited to a livestock context (PRA being of course only part of the process of participatory research) such as Kirsopp-Reed (1994) and Waters-Bayer and Bayer (1994). But participatory research is by its nature highly context-specific and difficult to reduce to the format of a manual. Nor was it possible for the Link project to attempt to review global experience of participatory livestock production research (which would have been necessary for a manual), although we are aware of interesting experiences in India (Conroy and Rangnekar 1999, Conroy in press) and Latin America (Simon Anderson, pers.comm.). In addition, it emerged early in the project that the concerns of researchers lay as much or more with conceptual and institutional issues as with the choice of particular research tools.

¹ This paper borrows heavily from Morton *et al.* 1997, which had inputs from Steve Ashley, Danni Romney and Professor Louis Mtenga. The current paper has greatly benefited from the assistance of all those in Kenya and Tanzania who were interviewed and made literature available, of Barbara Adolph who collated and reviewed that literature, and also of Steve Ashley who commented on advanced draft. Responsibility for views expressed here remains the author's alone. This publication is an output from a research project funded by the United Kingdom Department for International Development (DFID) for the benefit of developing countries. The views expressed here are not necessarily those of DFID. [R6776]

Accordingly the paper attempts to highlight some key issues, conceptual and institutional as well as methodological, out of the diversity of experiences and views gathered. We have attempted to concentrate on issues specific to livestock research, but we have also discussed areas where the experience of livestock projects casts particular light on general participatory issues.

The two projects linked were firstly that carried out by Reading University, in collaboration with Sokoine University of Agriculture, Livestock in Development and NRI on “Husbandry strategies for improving the sustainable utilisation of forages to increase profitable milk production from cows and goats on smallholder farms in Tanzania” (see Ashley *et al.* 2000). This project identified problems and opportunities in the semi-arid area of Sukumaland, and the higher potential areas of Kilimanjaro and Mgeta, and went on to investigate improvements in the management of feed in Kilimanjaro. The second was that carried out by NRI, ILRI and the Kenyan Agricultural Research Institute on “Evaluation and improvement of feeding strategies for optimising feed intake in crop/livestock systems”, which took place among small-scale dairy producers in Kiambu District, adjacent to Nairobi (see Morton and Romney 2001, Lukuyu *et al.* 2001). The LPP funded the “Link Project” specifically because the two projects share a participatory approach and a concern with dairy systems in relatively high potential areas, and because it is felt that participatory research methodologies are less well developed for livestock production than for research.

This paper is based on a previous version (Morton *et al.* 1997) stemming from a workshop for researchers on the two linked projects and others held in Arusha in April 1997. This workshop was very useful in identifying the major concerns of livestock researchers in developing countries faced with the option of participatory research. It incorporates information from visits to research and development projects in Tanzania during 1997 and Kenya during 1998, and review of documents obtained.

This introduction carries on to identify the main institutional contexts in which research is carried out and is used; in other words some of the main stakeholders in research. The following three sections highlight three different sorts of issues: *conceptual*, relating to the objectives and definition of farmer participatory research, in general and in relation to livestock production; *methodological*, relating to methods that can be used at various points of the research project cycle; and *institutional*, relating to the constraints placed on farmer participation by the institutions that fund it, implement it and use it.

Institutional Contexts for Research

Livestock production research, in a narrow sense, is carried out in countries of the South primarily by NARS and local universities, assisted in some cases by universities or other institutes from the North, or international research centres. It may be funded by donors (in some cases using Northern Universities as intermediaries or research managers) who may target their funding in various ways. In a broader sense “research” is also carried out by donor-funded development projects, and by NGOs: these may also be regarded as users or “uptake pathways” for research in the narrower sense. More detail is given below of each of these categories of actor, and of the way they commission, implement, use and interact with research.

National Agricultural Research Services

Developing countries typically have dedicated national agricultural research services (NARS²), separate from teaching universities. These services may fall under ministries of science and technology (as with KARI in Kenya) or under ministries of agriculture (as with the Department of Research and Training in Tanzania). Such organisations will have the major mandate for agricultural research. Research priorities may be identified by the scientific interests of researchers, or by consultation with producers or their representatives, or by various combinations of these approaches. In practice NARS are likely to be dependent on donor funding for much of their research activity. Donors may use research funding as a way to build capacity or lever institutional changes in the direction of more client-oriented research or better dissemination of research.

Relations between NARS and southern universities may be problematic and characterised by conflict over scarce resources. NARS relations with agricultural extension services vary widely; they may require memoranda of understandings to govern relations between the two, especially if they fall under different ministries. Where national extension services have been designed wholly or partly along "Training and Visit" lines, research-extension linkages will probably be formalised and channelled through particular individuals.

Southern Universities

Even where NARS (in the narrow sense) exist, national universities may be major players in agricultural research. It is very hard to generalise about their strengths and weaknesses: they may be less bureaucratic and more innovative than NARS, or more concerned with academic output at the expense of effective dissemination to farmers. They may have less access to research funds from agricultural development donors, but may benefit in other ways from links to northern universities and educational foundations.

Northern Universities

² The acronym can be used more broadly for National Agricultural Research *Systems*, including Universities and some parts or aspects of extension systems. It will be used in the narrower sense here.

Northern universities and other non-profit research institutions typically carry out agricultural research in developing countries under funding from development donors, less frequently from their own resources or national research funds in their own countries. They may maintain long-term relations with particular southern universities or NARS, which enables, explicitly or otherwise, a degree of "capacity-building". Northern research institutions may display a concentration on academic output and a limited view of their own role in development, and may be subject to funding and other pressures. Northern universities typically include study for a Ph.D. in their research projects - this may have major advantages in incentivising researchers and building research skills in the long term, but may also have disadvantages in reducing researchers' flexibility to do more participatory research.

International Agricultural Research Centres (IARCs)

IARCs include centres of the Consultative Group for International Agricultural Research (CGIAR) and certain others; within the field of livestock research in East Africa ILRI is of course pre-eminent, and ICRAF is also significant through its research on multi-purpose trees. IARCs enjoy long-term relationships with NARS and southern universities, especially in the countries where they are headquartered, relationships that can contribute to capacity-building. IARCs are well-resourced and have core-funding, although they also seek funds for specific projects from donors. From a concern with highly strategic scientific research, the CGIAR centres have moved (not all at the same rate) to include a more systems-based approach, and latterly an interest in participatory research.

Donors

Donors fund livestock research in various ways: through central research funds, through country research programmes or through development projects. Central research funds, of which LPP itself is an example, have a mandate to fund research in a chosen field, in this case livestock production, across a number of countries. While different management arrangements are conceivable, in the case of LPP this has implied a) competition between research proposals from within one country and between countries, b) a general tendency for projects to be led by a northern institution with collaborators from the South - a NARS or a local university, and c) a lack of emphasis on capacity building within Southern research institutions. A country research programme, of which DFID's and the Netherlands support to NARP-II are examples, is dedicated to research within one country, may have less of a formal competitive element, and may have stronger capacity building element for the host institution, in this case the NARS. There may be even more specific research projects funded out of bilateral development funds, dedicated to a particular centre of the NARS or a specific university. The Netherlands-funded Lake Zone Farming Systems Research Project in Tanzania is an example.

The development programmes of bilateral and multi-lateral donors may carry out research, either in a relatively narrow sense, or in a broader sense if monitoring and evaluation activities are included (as for example in the GTZ Integrated Small Livestock Project in Kenya). They may also play host to external researchers, supplying data (as the Netherlands-funded Tanga Dairy Development Project did to the LPP-funded research project on "The development of feeding strategies to improve reproductive performance and milk yields of cows in high potential, mixed farming systems") or facilities and support (as ISLP did to researchers from German Universities). They may also be users of the outputs of research.

NGOs

Much the same range of relations to research characterises NGOs. NGOs may be carrying out a great deal of "research" in a broad sense, in that they actively investigate the production systems in which they intervene, and may play host to more formal research. However, many NGOs see research in the more traditional sense as something external to and irrelevant to their work (E. Kinsey of HPI, pers comm., see also Morton et al. 2000 a and b).

Conceptual Issues

This section deals with the most general issues surrounding participatory research, its definition, objectives, and relations to more traditional agricultural research, and whether and why participatory methodologies are less developed in the field of livestock production.

Degrees of Participation and Diverse Routes to Participation

It was clear in the Arusha workshop that the term "participatory research" is a very emotive one, particularly when contrasted, as it often is, with "extractive" research. There is a danger that an unrealistic ideal of participatory research may be seen as unobtainable, and may in fact discourage researchers in NARS and southern universities from increasing farmer participation. The comment by Okali *et al.* (1994) on the sharp either/or dichotomies often found in discussions on participatory research is relevant here:

"a central theme which emerges from our study is that the use of dichotomies...., that characterises many aspects of the literature and discussion relating to farmer participatory research, has been a major factor hindering both clarity of concepts and effectiveness of implementation."

It seems more appropriate to use a continuum of research types, such as the by now well-known schema proposed by Biggs (1989). As well as replacing a dichotomy with a continuum, this schema allows for a range of objectives for research, all quite valid in the right contexts. It therefore encourages a characterisation of research projects or programmes, rather than research activities considered in isolation. This is especially important if we accept, as the Arusha workshop did, that there are strong arguments for the continuing importance of on-station research (see also below).

Contract	Consultative	Collaborative	Collegial
Farmers' land and services are hired or borrowed, e.g. the researchers contracts with the farmer to provide specific types of land	There is a doctor-patient relationship. Researchers consult farmers, diagnose their problems and try to find solutions	Researchers and farmers are partners in the research process and continuously collaborate in activities	Researchers actively encourage the informal R&D system in rural areas

Source: Biggs (1989) as presented in Okali, Sumberg and Farrington (1994)

Using this schema, it is clear that for the LPP-funded and NARP-II funded projects (as represented at the Arusha workshop), the issues have been whether they as projects are closer to the consultative or collaborative points of Biggs' continuum, what advantages there would be to becoming more collaborative, and how they, and future research projects, might do so.

The objectives of "collegiate" research, the most participatory point of Biggs' continuum, can be seen as those of strengthening farmers' own capacity for research and development (Farrington and Nelson 1997). There does not appear to be any livestock research project in Kenya or Tanzania purely driven by such an objective. Such an objective was certainly not primary for either of the two DFID-funded projects (nor the LPP which funds them). For these projects, and others like them, the advantages of a collaborative over a consultative approach might be summed up in the words of Okali *et al.* (1994):

"At a technological level, the aim of farmer participatory research is to understand the main characteristics and dynamics of the agro-ecosystem within which the community operates, to identify priority problems and opportunities, and to experiment locally with a variety of technological 'options' based on ideas and experiences derived from indigenous knowledge and formal science."

Farmer participatory research in this area is, quite properly, a means to an end: involving farmers in the sorts of ways under discussion is a means of doing research which is relevant and whose findings will be adopted by farmers. With livestock research as with other research sub-sectors, there is a real feeling that much research to date has not been relevant and has not been adopted (Bangu 1994).

For the two DFID-funded projects, there was a particular need to assess carefully the degree of participation that is required and is practical. Farmer participatory research is recognised as particularly appropriate to low potential areas (Okali, Sumberg and Farrington 1994). With respect to rainfall and soils, Kiambu District and Kilimanjaro Region can be considered 'high potential' at least within an East African context. Kiambu is additionally favoured by its vicinity to Nairobi, which represents an enormous market for milk.

However, both Kiambu District and Kilimanjaro Region are characterised by very high population densities, small and fragmented holdings and a shortage of agricultural labour. Dairy producers in both areas have not, up to the last few years, been well served by research institutions, particularly the poorer strata that both projects identified and targeted. To this extent we remained confident that some form of participatory approach is both necessary and possible. The fact that both projects were mainly concerned with small-scale dairy production using crossbreds, which have been introduced relatively recently, lessens the importance of indigenous knowledge, but by no means eliminates it. It places an added burden on the projects to incorporate on-station work, which both agree is necessary, into an overall collaborative framework.

The ways in which participatory and on-station activities are ordered and co-ordinated differ considerably between the different projects, which bears out the idea that it is projects or programmes, and not research activities in isolation, that should be evaluated for their "degree of participation". It was strongly felt at the Arusha workshop that there might be many roads to participation. Figs. 1 and 2 illustrate this by portraying the two DFID-funded projects, and one other LPP-funded project in Tanzania, as flow-diagrams.

The diagrams are based principally on the project memoranda for these projects rather than the way in which they evolved, and are necessarily highly simplified. They also omit an important difference between the "Husbandry strategies" project and the other two: that the latter both started from an existing scientific problem, while the "Husbandry strategies" project started from a less restrictive interest in the constraints to productivity felt by Tanzanian livestock owners. Nevertheless the diagrams represent visually the way in which different combinations of "participatory" and "non-participatory" activities can deliver research relevant to farmers, modified by farmers and (hopefully) adopted by farmers.

Figure 1: Husbandry strategies for improving the sustainable utilisation of forages to increase profitable milk production from cows and goats on smallholder farms in Tanzania

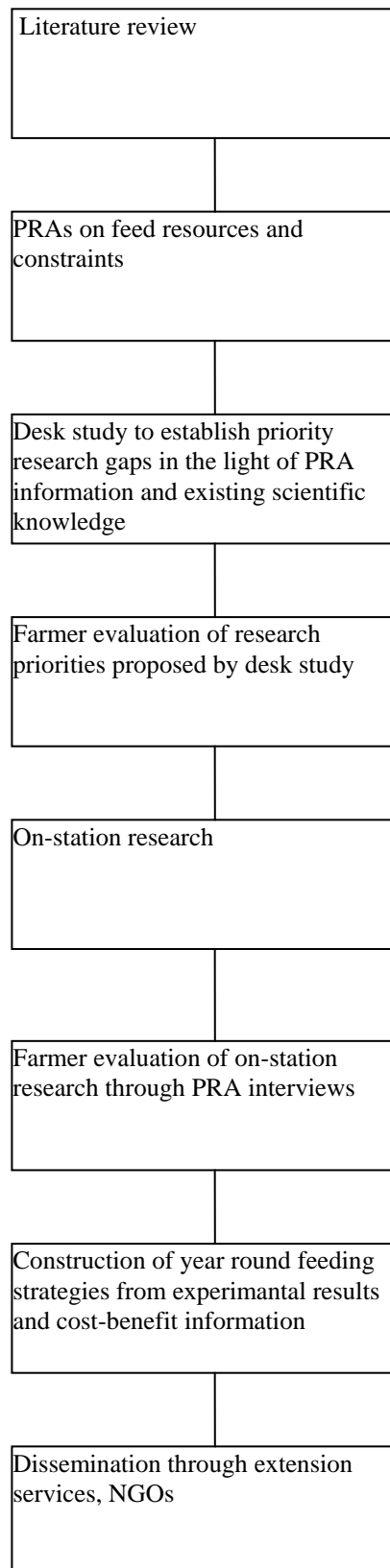


Figure 2. Evaluation and improvement of feeding strategies for optimising feed intake in crop/livestock systems

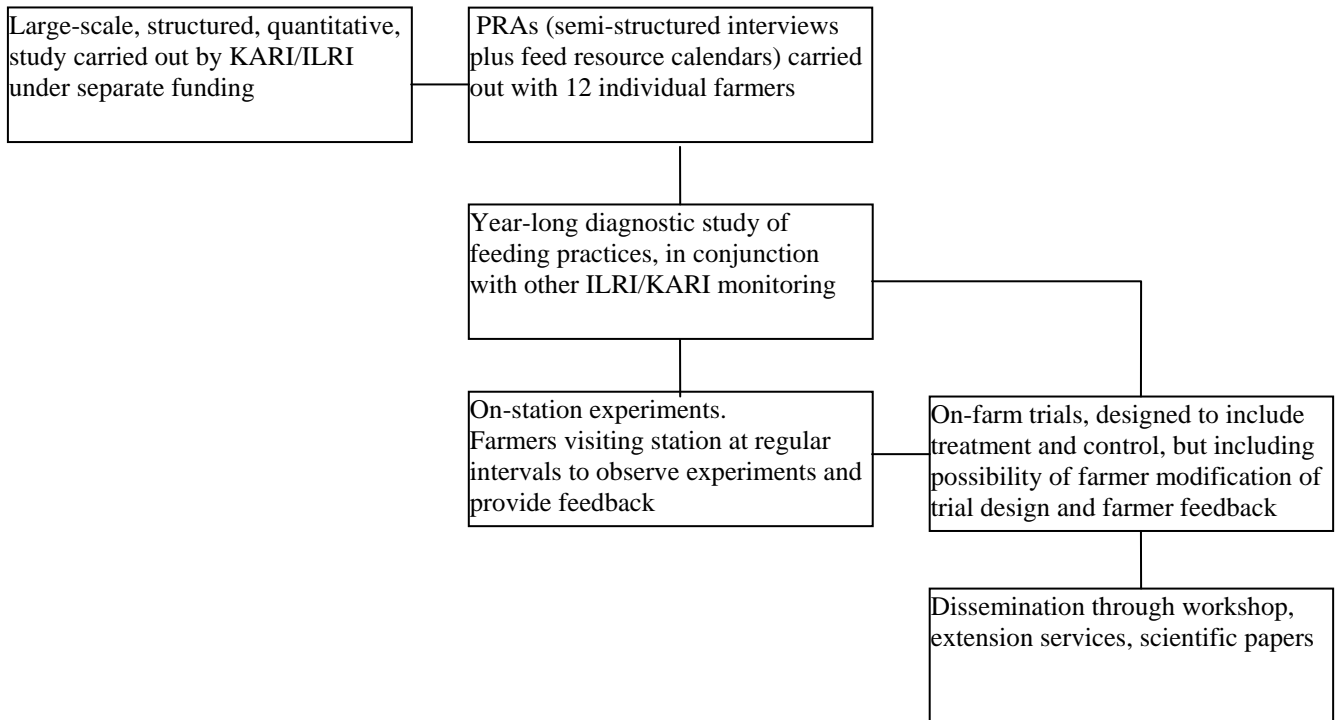
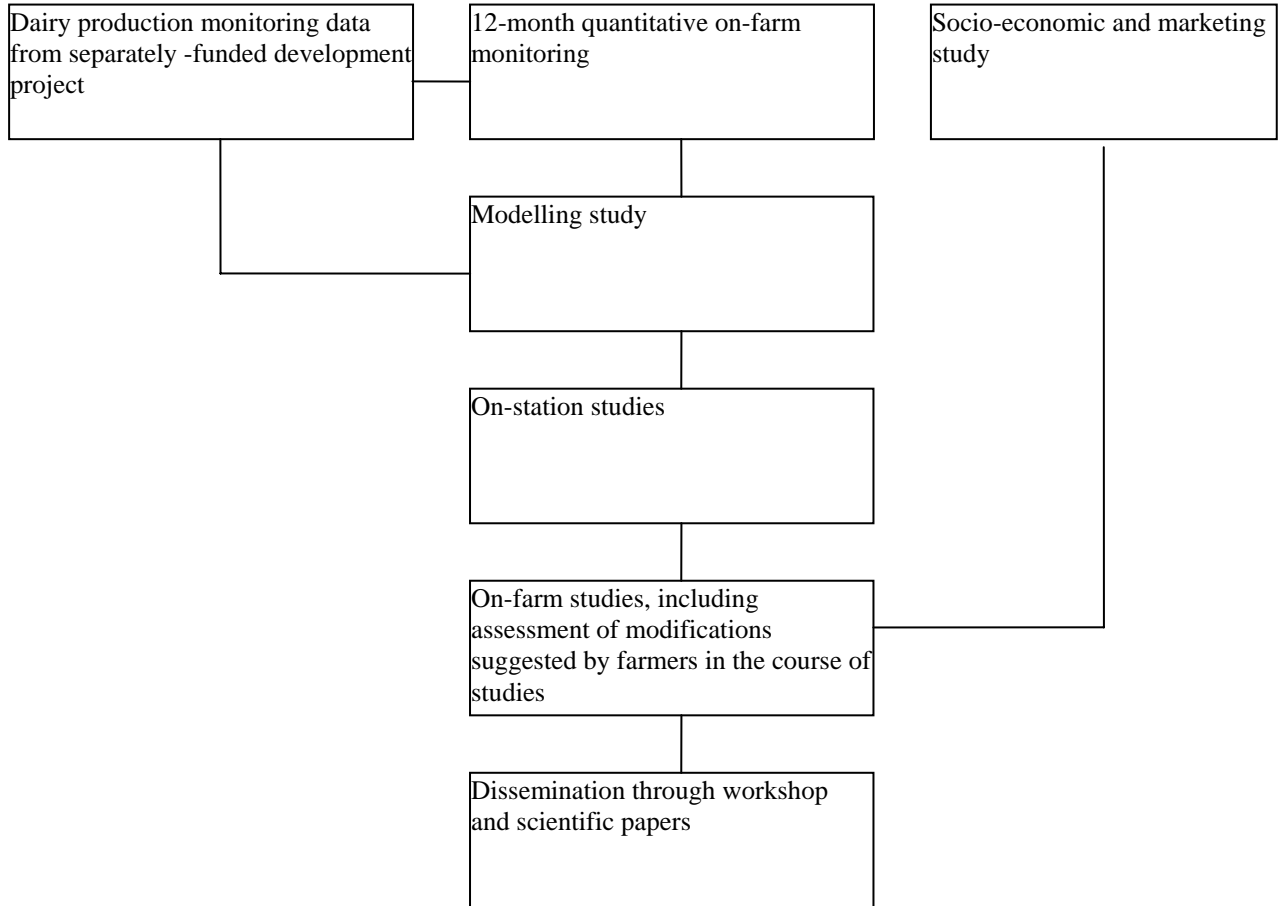


Figure 3: The development of feeding strategies to improve reproductive performance and milk yields of cows in high potential, mixed farming systems



Why are participatory methodologies less developed for livestock research?

The Arusha meeting was premised on the underdevelopment of participatory methodologies in livestock production as compared to crop production and crop protection, and the participants agreed with this premise, as did most other stakeholders interviewed. The main reason put forward for this state of affairs related to the value of livestock. Livestock (particularly dairy cattle) are valuable and 'lumpy' assets. The risk to a farmer of using one of his/her cows in an on-farm feeding trial, in terms of foregone production, loss of condition or worse, is likely to be much greater than the foregone production from a relatively small control plot. ICRAF for example do not carry out on-farm feeding trials comparing treatments and a control, only different treatments, partly because of the ethical issues raised.

We can identify additional reasons for the gap between participatory livestock research and participatory crop research. To some extent these are features of on-farm livestock trials whether participatory or not, but exacerbated if a participatory approach is desired:

- the greater timescales involved in livestock research: this is particularly true of breeding research, but also applies to other research, which may, for example require the entire growing cycle of a fodder crop, followed by the entire lactation cycle of a cow.
- small numbers of livestock, particularly cows, leading to problems in sampling procedures, and in particular problems of replication (non-participatory on-farm research can alleviate these problems by enforcing standard treatments and controls across a range of farms, participatory research cannot).
- The practicalities of identifying and tagging animals (which, unlike crops, move)
- Basal diets against which treatments are compared may vary greatly across farms and fluctuate dramatically for any one farm
- Fertility research is faced with disaggregating the multiple factors influencing livestock fertility.

As is discussed below, these problems are felt differently according to the institutional contexts of research, and can be circumvented by a number of methodological strategies (proven or speculative). But in general they still amount to important and inherent difficulties facing participatory livestock research.

In addition, there are a number of more contingent historical reasons for the underdevelopment of participatory methodologies with livestock:

- a smaller global community of researchers, and a lesser probability of a 'critical mass' of participatory-minded researchers emerging
- the early contribution to participatory research made by a few of the CGIAR centres with a crop mandate (IRRI, CIAT, CIP)
- the lack of simple, dramatic and popularizable findings, comparable to the vindication of intercropping by participatory crop research.

Beyond all these, Ashley et al. (2000) argue that animal production as a discipline is heavily oriented to working with single production objectives and is inherently challenged by the multiple objectives of resource-poor livestock keepers. While it is true that multiple objectives, especially those less important in developed economies, need careful investigation, it seems unnecessarily pessimistic to include that the discipline (appropriately assisted by other disciplines) cannot manage this task. It does however point onwards to the importance of whole-farm, and ultimately of livelihoods, research.

Participatory research, whole-farm research and livelihoods research

We must note here that the vocabulary of participatory research, especially as presented here, is far from universally used, nor is it the only dimension along which research can be evaluated. Netherlands-funded research in particular tends to describe itself as Farming Systems Research or Client-Oriented Research. Dutch researchers and their colleagues also see a tendency for UK-funded research, even at the more participatory end of the spectrum, to remain commodity-focussed and in their view less relevant than research that takes a whole-farm perspective (De Jong, Musikira, pers.comm.).

The argument for a whole-farm perspective is very persuasive (see Schiere nd), and livestock research that successfully addresses livestock problems of mixed farmers (be it in a consultative, collaborative or collegiate way) is very likely to have a strong farming systems orientation. The poor, as is now well known, keep livestock for a number of reasons, including contributing to the productivity of cropping through manure and draught power (Powell, Pearson and Hopkins 1998). Many feed sources for livestock are likely also to produce other benefits for poor households (see Lukuyu 2000 on maize as feed and food, see Franzel *et al.* in press on calliandra as a fuelwood source and a soil conservation measure) or impact on their ability to achieve such benefits. For the majority of the rural poor, even when crop and livestock production are not "integrated" in the classic sense, there will be sufficient positive and negative synergies between livestock production and other farm activities to make a case for adopting a whole farm perspective.

However, the critique of livestock research from a farming systems perspective can and should be broadened. Livestock production has to be seen not only in a whole-farm perspective, but in a livelihoods perspective. Livestock production is one possible livelihood strategy that the poor can

adopt, given their endowment in the various forms of capital, and the institutions that shape their lives. There are trade-offs in the use of those assets; the farming systems approach clearly indicates trade-offs in land (natural capital) between fodder and other crops, but there are equally trade-offs in the use of labour (human capital) and financial capital between livestock production and a variety of non-farm livelihood strategies. Similarly there are synergies, livestock can serve as a form of investment, an asset used for consumption-smoothing, or can be marketed following links established in the course of other livelihood strategies.

The adoption of livestock production technologies is influenced not only by the farming system and other livelihood strategies but by policies, institutions and incentives (Franzel *et al.* in press). Land tenure and milk marketing institutions and pricing policies are obvious examples. Awareness of such issues should be introduced into the research cycle at various points:

- Researchers should be generally aware of the sorts of policies and institutions that affect livestock producers
- Policy and institutional factors likely to affect adoption can be explored during initial PRAs
- Such factors can be incorporated informally or formally (this applies particularly to pricing) into ex-ante sensitivity analyses
- As Franzel *et al.* (in press) point out, farmer-designed and -managed on-farm trials can yield valuable information on policy constraints, in combination with technical interventions or in their own right.

A related issue is that, if overall circumstances (including policies and institutions) are favourable, adoption of livestock technologies may have "downstream" benefits not only on producer household income, but on nutrition, gender relations, and secondary employment. Some livestock development projects (e.g. the Kenya-Finland Livestock Development Project) make such downstream benefits very much part of their project rationales. The extent to which such benefits should be monitored depends very much on the overall objectives of a project, but even research projects funded as such should be aware of such benefits and the extent to which they may be uncovered in farmer-managed trials.

Economic analysis

Another issue raised by Netherlands-funded researchers during consultations for this paper was the relative absence of *ex-ante* economic analysis in DFID-funded research. Netherlands-funded research has a greater tendency to use ex-ante analysis, including sensitivity analyses, to screen interventions for testing - for example, work on molasses-urea blocks was dropped after such analysis. The comment can be broadened to include economic analysis at various points in the project cycle. While adoption in the course of participatory trials is itself an important indicator of sustainability, economic

analysis can be very important in establishing the prospects for broader adoption across locations or strata of farmers. There are however many obvious problems in conducting economic analyses in this way: the unreliability of quantitative data obtained from farmers, the necessity to impute values to "free" resources such as open grazing, family labour or manure, the problems of heterogeneity within farming communities and of seasonality. The trick must be to use economic analyses in the most appropriate and focussed way, and not beyond the limits of the available data. "Participatory farm management" tools (Dorward et al. 1997), which lie somewhere between PRA tools and traditional quantified economic surveys may be of value here.

Issues - methodological

In this section we want to look at the issues that arise for participatory research in relation to various stages of the project cycle - project identification, baseline research, trials, evaluation, dissemination - and some of the strategies advanced to make research more participatory at these various stages.

Clarity of objectives

Research projects, as discussed above, can take their place along a continuum of degrees of participation, a place determined in part by their funding and institutional context and a place that in turn has implications for which has implications for overall research design and for particular methodologies. Given all this, we feel it is very important for research projects to be clear and consistent about their objectives, and about what they are *not* intending to do. The objectives of research will influence the internal design of the project, its mix of on-station/on-farm activities and of quantitative/qualitative methodologies (see also Franzel et al. 1998), but also its relations with extension (see below - and possibly also with policy makers), and the most appropriate forms of dissemination. A clear statement of objectives also has implications for how a research project's success should be monitored and evaluated.³

Identification of research problems

At the "collegiate" end of the continuum (see above) research problems would be identified in each target community through participatory methodologies, ideally a leisurely and well-resourced participatory rural appraisal (PRA).

³ These issues, and the relations between logical frameworks and participatory research, are explored in detail by Farrington and Nelson (1997).

For most research projects, direct investigation of the needs of livestock producers will be only one element in a process that also includes:

- the pre-determined priorities of research programmes and those who fund them,
- researchers' perceptions of what is scientifically interesting,
- and secondary information on producers' needs at a national or regional level (for a particularly systematic and quantitative example of the latter see McLeod et al. 1998).

These elements can be of varying importance, and combined in different ways. In addition, an understanding of the needs of livestock keepers is likely itself to include:

- a general 'systems understanding' on the part of the researcher, *and*
- needs explicitly articulated by farmers.

In the Tanzanian project the choice of research topic was left very open in scientific terms, within certain constraints: that it should focus on feeding for smallholder milk production, and accommodate the needs of an animal production PhD (Ashley et al. 2000). PRAs were conducted in three locations to understand local livestock production systems and their problems. The combination of this process with desk studies of scientific literature was designed to identify scientific "missing links" suitable for research, which could then be refined through further PRAs. This combination proved surprisingly difficult and involved an element of compromise.

In the Kenyan project the broad technical area for investigation - intake - was identified in advance through a general reflection on the needs of Kenyan smallholder dairy systems. Precise topics within this area were then developed through a compromise between PRA findings and what was scientifically interesting and feasible with the financial and human resources involved. Initially this resulted in a "purely" scientific research design, on alternation of diets, carried out on station. Later in the project new possibilities of financial and human resources allowed a second and more participatory sub-project of research on the agronomy of maize grown as fodder.

PRA as tools and as a worldview

Many discussions of PRA by its best-known proponents consider it as an approach to, or a worldview of, development work. Such a view stresses long-term engagement, and participation of farmers in planning development activities as well as in information gathering. In practice, in both research and development, PRA is seen as a collection of tools, mainly concerned with visualisation, and used instrumentally⁴ to gain information for a particular

⁴ Using PRA or more traditional data-collection methods in this way is sometimes labelled *extractive* as

purpose over a fixed and relatively short time-scale. Rather than take sides in such a debate, or spend time policing the boundaries of RRA and PRA, we note that the contrast corresponds quite closely to the different ends of the research continuum, with PRA as a worldview being associated with collegiate research, and PRA as a set of field methods with contractual and consultative research. Researchers seeking to move their research from a consultative to a collaborative style would do well to consider the broader purpose of PRA as a critique of existing approaches, but this does not preclude a careful consideration of the methods that have become known as "PRA tools".

The different field methods used within PRA are well-described in a number of places, and methods for use in livestock research and development are described in Kirsopp-Reed 1994, Waters-Bayer and Bayer 1994, Roeleveld and van den Broek 1996, and from the Tanzania research project under consideration, Ashley 1997. A brief discussion will be adequate here:

Semi-structured interview must be the backbone of any PRA activity, including that for livestock research. "Semi-structured" is the key: checklists should be used flexibly to aid the interviewers and to ensure that nothing relevant is missed out, rather than as questionnaires.

Participatory mapping is a technique that proves very useful with livestock producers. This is perhaps more the case with semi-extensive and extensive systems than with intensive dairy systems, but maps can also be used to explore marketing, input supply and service provision linkages.

Ranking and scoring techniques can be used to evaluate constraints to livestock production, the comparative value of different feeds, and the different objectives/outputs of a livestock species. In the first case care needs to be taken in interpreting results: constraints operate in combination and the most obviously limiting is not necessarily the most fundamentally important. "Lack of information" if cited as a constraint does not necessarily imply that available or potentially available information would solve the current problems.

Ranking of feeds is also problematic, and needs considerable care in communicating with interviewees. Are they being asked to compare feeds in the quantities available, or quantity for quantity? Can there be meaningful comparison between cut and carried fodders, purchased feeds and grazing? Are feeds being evaluated on only one axis or on more than one axis representing different purposes such as energy and milk production (see also Thorne and Herrero 1998 and references cited therein)? All these questions

contrasted with participatory. We prefer to avoid this terminology; creating knowledge by surveys, even if that knowledge is not returned directly to the community, is an honourable activity and hardly needs to be compared with strip-mining.

need to be faced and what is being asked of producers communicated with precision and if possible in a standardised way across individual interviews. Franzel (1993) discusses the use of the traditional *bao* game for evaluating tree species against different criteria (one of which is use as fodder) and gives some practical guidelines for using the game in a standardised way.

Ranking of production objectives/outputs of different livestock species, (for instance using cards with drawings of a bucket of milk, a plough, a currency note) can be a very useful tool, though perhaps less so in dairy systems where production objectives are relatively clear. Again, care has to be taken in specifying whether objectives are being compared for each species or vice versa. For a more quantified version of this approach see Bennison *et al.* (1997).

Calendars are a crucial tool in participatory livestock research. Calendars can be used to obtain information on seasonal labour demands and on seasonal feed availability and use. For this purpose they can be combined with ranking and scoring techniques. If this is done, the remarks on ranking and scoring of feeds above need to be taken into account, and it also needs to be made clear whether feeds available within a particular month are being compared against each other, or whether the use or value of feed is being compared across months (in which case, it must be clear if the comparison is of quality or of quantity and of availability or use)(see Morton and Romney 2001).

Pile sorting "proportional piling" can be used in various ways, some of them similar to the uses of ranking or scoring, bearing in mind the difficulties of quantification, particularly of unlike things. Pile sorting might have particular uses in prioritisation of research topics.

Going beyond the discussion of particular tools, the Arusha workshop and others contacted during this study were concerned with issues of 'good practice' in PRA (not specific to livestock research), such as:

- the appropriate size for a PRA team, and the importance of team-building around agreed objectives. The dangers of too many specialists pursuing their own agendas, leading to overlong and unfocussed sessions were recognised. At the same time, the pressures to have all the sponsoring organisations represented were seen as sometimes unavoidable, but manageable through splitting the team.
- language: PRA reports seldom make much reference to the language in which they were conducted, and which of the participants (researchers or farmers) were fluent in that language.

- “beneficiary fatigue”: the possibility of tiring informants through overlong and/or repeated sessions was mentioned repeatedly. In truly participatory research this danger can be minimised by building trust between researchers and farmers over time, but even then must continue to be borne in mind.
- the longer-term issues of trust and communication: the presentation at Arusha of the Lake Zone FSR project showed the lengthy timescale necessary to build up the trust needed for participatory research, which inevitably raised once more the issues of constrained timescales for research projects. The importance of learning communication skills for bridging the researcher-farmer divide (which often exists even with researchers themselves one generation from the land) was also stressed, and there were calls for donors to fund short courses in these skills for African researchers. This issue needs to be considered in a much broader context than that of PRA training (see also Okali, Sumberg and Farrington 1994).

On-farm Trials

Participatory on-farm trials are usually regarded as central to participatory research. As discussed above, the particular difficulties of carrying out participatory on-farm trials with livestock can be seen as a key reason why participatory research in general has not developed in the livestock sector.

Our two linked projects do not themselves, for better or worse, cast much light on this issue. The Tanzanian project was designed without on-farm trials (though with PRA studies to gather farmer feedback on researcher-managed trials). The Kenyan project, mainly for institutional and human resource reasons, came to include as its central activity a wholly on-station and researcher-managed piece of research. When a subsidiary research activity arose within the project, it was fundamentally a set of agronomic trials, without a feeding component, and not therefore addressing the specific issues in participatory livestock trials.

Nevertheless, discussions with researchers during the Link Project help to identify some of the central issues, and some ways in which they may be addressed. One issue that is generic to both livestock and crop research is the trade-off (real or supposed) between participation and scientific rigour in on-farm trials. Put simply, the greater the degree of control that farmers have over trials, the less the experiments are likely to produce data that conforms to normal scientific standards. Farmers' control of experiments is likely to lead to: distribution of farms or animals between treatments being unbalanced; parameters other than those focussed on not being held constant; farmers modifying treatments during the trial; "control" farmers adopting one of the

treatments half-way through the trial and many similar occurrences that make the production of easily analysable datasets difficult.

The most important point to make about this trade-off is that it is closely linked to the objective of the research. If the objective is to develop technology that will be adopted by farmers in the project area, it will not be necessary to produce scientifically valid data. If the objective is purely the production of scientific knowledge, then farmer participation will be seen as wholly negative. In between these two poles lie the majority of on-farm trials, where the development of adoptable technology is the overall aim, but combined with factors such as:

- the sorts of institutional and professional concerns discussed elsewhere in this paper,
- a desire to increase understanding of the scientific factors involved, which in turn is likely to be linked to
- a concern for the adoption of the technology to be replicable over larger areas and varying conditions.

It is in these cases where the trade-offs between participatory and scientific objectives will be most felt, and modifying research methods to increase scientific rigour is likely to impact negatively on participation. In each case the extent to which methodologies are "scientific" or "participatory" will depend on the exact combination and hierarchy of objectives. This is not to say that nothing can be done to mitigate these trade-offs. At least three distinct mitigating strategies can be identified:

Training: There are real possibilities for developing with farmers a shared understanding of the basic scientific concepts involved and why they are useful in producing new knowledge. This applies especially to the concept of control. There are well known anecdotal examples of livestock keepers spontaneously adopting controls in order to assure themselves that positive results they saw in their livestock were definitely the result of specific treatments (see for example, Swift cited in Chambers 1983). With training, and equally importantly, *time*, such understanding can be widely shared. However, as discussed elsewhere in this paper, time is likely to be at a premium in projects funded on research budgets.

A group approach: if the basic concepts that underlie the research design can be understood in this way, the adherence of farmers to trial design can be increased by encouraging them to view it as a collective responsibility. In this way, treatments and controls can be divided up between farmers. Assuming that farmers accept the overall importance of the trial, they may be more likely to accept that it is necessary to adhere to a single treatment (or control) if such adherence is seen as a service to the group as a whole. Under certain circumstances (if other factors are constant across farms or can be analysed out) group approaches also help to overcome the problem of very small

sample sizes, or one-cow herds. Again however, forming, training and managing groups to accept such collective responsibility is a time consuming task.

Innovative statistical methodologies: Many of the problems associated with the analysis of participatory on-farm trial data are statistical and increasingly have statistical solutions. The major problems specific to livestock research are associated with the presence of only one or two animals per farm, leading to large variations within the sample, particularly as regards management practices. A generic set of problems with participatory research is that of unbalanced datasets. The first set of problems are discussed in the booklet by the University of Reading (2000), with particular discussion of the pros and cons of "within-animal" experiments - crossover and switchback designs. The second set of problems is touched on by Martin and Sherington (1997), who observe that software and hardware are now available for researchers to carry out analysis of variance on unbalanced, multi-factor data sets.

A separate major issue with participatory on-farm trials, that does present itself more acutely with livestock trials, is that of risk. While the sorts of feeding trials our projects were most concerned with – uses of forage already available on farm – were not highly risky, any experiment carries some degree of risk, if only that of loss of condition. It has been pointed out that some research on tree fodders may pose risks of toxicity (Paterson *et al.* 1996). If an intervention begins to prove successful, not adopting it, in other words adhering to a control regime, also begins to become a risk. Where the risk is to a large household capital asset such as a dairy cow (rather than just the annual yield from a small trial plot) it becomes an important practical and ethical issue.

Again, there are strategies for mitigating this element of risk, or making risk more acceptable to farmers. The first, obviously, is observing principles of information sharing and voluntarism. Farmers need to be told what the risks of interventions are, and what the limits of researchers' knowledge about those risks are. When such information is shared, farmers must be free to choose whether to participate in trials, and ultimately whether to withdraw from trials in progress. In order to limit the ethical and practical problems associated with enforcing a control regime on some farmers, ICRAF have tended to run trials comparing different treatments, rather than comparing a treatment and a control (Franzel, pers.comm).

There are also possibilities of researchers sharing farmers' risks through financial means; cost-sharing, financial guarantees against loss of animal value. One interesting example is the research on concentrate feeding (Romney *et al.* 2000), where loans were provided to allow farmers to feed high levels of concentrate in early lactation. In this case there was a very close fit between the intervention being tested and the need for a financial mechanism.

Cost-sharing and similar approaches may raise problems of appearing to give handouts, and making the research less participatory because farmers have financial incentives, but should be explored. One speculative possibility for mitigating risk that was mentioned during the research was that of using commercial insurance (D M Njuru pers comm.), although it is unlikely that insurers would insure particularly risky interventions.

On-station trials

Researchers in the Arusha workshop, and others contacted during the project, tended to support vigorously the continuing necessity of on-station trials in the sort of research under discussion. The workshop participants also tended to disagree with what they understood as the current position of one major donor to the dairy sector in East Africa, the Netherlands, against on-station research.⁵ The support for on-station work stemmed partly from the sorts of institutional issues discussed elsewhere, and partly from fears that on-farm trials would be problematic and difficult in themselves. The methodological problems of on-farm research suggest that the objectives of on-farm work need to be defined very carefully and simply and point back to the necessity for good on-station work. Researchers feel the need to reduce complexity through 'scientific' investigation before taking a small number of options to on-farm trials. On-station work can help to generate "best-bets" that can be tested by farmers rather than relying on on-farm trials to explore relations between large numbers of variables. In as much as participatory on-farm livestock trials are seen as especially problematic (because of small and indivisible samples, risk, timescales etc.) livestock researchers can justifiably point to a continued need for on-station research. We also found a strong commitment to on-station trials, carefully identified and managed as part of an overall participatory process, among researchers strongly identified with participatory livestock research elsewhere in the world (Simon Anderson, pers.comm.).

On-station work can be seen as particularly relevant to the subject of both the projects considered: very small-scale commercial dairying in areas of high population density. This system is relatively new to the farmers, so the store of indigenous knowledge can be assumed not to be great, and the sorts of strategies that are or could be available to the poorest producers are not well understood by researchers. The Tanzanian project in particular justified on-station work by reference to 'missing links' in both farmer and researcher knowledge.

If on-station trials can therefore be seen as part of an overall participatory process, it highlights both general problems of identifying research priorities

⁵ More accurately, the Netherlands position is one that sees on-station trials as a last resort (Rijk De Jong, pers.comm). It should also be noted that the Netherlands-funded Tanga Dairy Development Project in Tanzania has been happy to collaborate with on-station research carried out at the Tanga Livestock Research Station.

(see above) and specific problems of obtaining farmer feedback on on-station trials. Ideally perhaps, the process should be iterative and incremental, with each refinement of on-station trials taken back for farmer comment, but the timescale of livestock feeding trials and the time constraints imposed by donors militate against this.

Dissemination

The dissemination of research was seen as an important issue throughout the project. One aspect of this was publication and professional reward systems, discussed below; another was described under the rubric of “research-extension linkages”. In many ways, discussion of this issues has been overtaken by the new discussions on dissemination around the LPP. What was clear, however, was that participatory research, which by its nature is localised, is not exempt from the obligation to think through ways of achieving wider-scale uptake. In Arusha the assumption was that wider uptake would typically involve national extension services, and the talk was of the different institutional and financial contexts in which such services exist, the necessity of their early involvement of such services in research, and the need for an understanding of their preferred form of message. A few years on, with further evidence of the collapse of national extension services (with the partial exception of Kenya) the terms of the debate may have altered towards NGOs and civil society organisations, but many of the principles remain.

Institutional Issues

During the course of the Link project, and especially at the Arusha workshop, it became clear that some of the greatest concerns that livestock researchers had about participatory research related to its institutional context. To a great extent these concerns are generic to all participatory research, but they are perhaps felt more strongly in the livestock sector because they combine with livestock-specific issues such as long research timescales and problems of small samples. Two sets of issues in particular arose: funding procedures and timescales, and reward systems for researchers.

There was a strong feeling at the workshop that the timescale and funding of the projects represented were major constraints on the degree of farmer participation that could be achieved. This was exacerbated by the greater timescales needed for livestock research. A leisurely timescale greatly facilitates the proper communication and the building-up of trust between researcher and farmer that is necessary for participatory research. Accepting that on-station research has a role in the overall research process, the process of obtaining of feedback from farmers plans for on-station work is

problematic. There is no consensus on how to do this, and it was felt that the ideal approach would be iterative and incremental: going back to farmers frequently to discuss relatively small packages of research findings or research plans. A short timescale limits the number of iterations that are possible between on-farm and on-station work. There was also a feeling that the *flexibility* necessary for truly participatory work, for example the flexibility to make radical switches in research topics, is difficult for donor-funded projects.

More specifically, however, the constraints on timescale, funding and responsiveness were seen as relating to the two projects' place in *a research programme, funded centrally by a donor*, and targeted at a number of countries. There was a strong contrast here with the Lake Zone FSR, where international assistance came from Netherlands bilateral aid to Tanzania.

Participants also saw problems relating to the projects' status as three-year Ph.D. projects. While there are strong arguments for donor-funded scientific research to be based on Ph.D. projects (arguments principally relating to incentives for developing country researchers) the three-year Ph.D. project is a very short timescale for participatory research. The requirements of a Ph.D. also steer researchers towards safer, more scientific, on-station activities, limit their ability to switch topics and approaches in mid-project, and give little incentive for researchers to work on design of extension materials and liaison with extension services.

There was some interest at the workshop in the funding of separate project identification exercises, or longer projects subject to review points, to allow the understanding of systems and the participatory choice of research topics before the formal beginning of a Ph.D. programme. Such arrangements have recently been made under the LPP, although not with Ph.D. projects. The workshop also recognised the risk of such an exercise creating farmer expectations, which would be disappointed if the longer project was not funded or was subject to delays. We nevertheless feel that participatory research projects that are also Ph.D. projects should be funded over four years.

A further suggestion is that universities should be more imaginative in their choice of external examiners for Ph.Ds, using non-academic professionals such as senior extensionists, representatives of formal farmer organisations or co-operative officers.

In addition, it was a very important concern of the workshop, and of livestock researchers visited subsequently in both countries, that on-farm data is not considered suitable for publication in the peer-reviewed academic journals on which professional reward systems for researchers are based. It is certainly the case that reward systems in NARS give very heavy weight to peer-

reviewed publications, to the possible detriment of other forms of output, and that many journal editors are suspicious of the “scientific” value of on-farm, and particularly participatory, data.⁶ However, there are dissenting voices. International researchers associated with Netherlands funding (Rijk De Jong pers.comm., J B Schiere pers.comm and n.d) tended to downplay this concern, by pointing out that there are ‘softer’ but no less esteemed journals that will publish participatory research, and that many researchers in NARS will not achieve a high publication in either participatory or conventional research. There are also signs of change in the reward systems themselves, particularly in Tanzania.

Conclusions

This paper has been exploratory, rather than aiming to reach firm conclusions or guidelines for participatory livestock research, but some concluding remarks are in order.

Firstly, clarity of objectives was a constant theme. Not all research can, or should be, highly participatory: what is important is to match methodologies to objectives. For much research, particularly funded by research budgets, this is likely to mean nudging research slightly from a consultative towards a collaborative mode.

Secondly, there are important reasons why participatory methodologies are less developed for livestock research, and these must be understood.

Thirdly, however, many of the most important constraints to participatory research are institutional, are shared with participatory research in any sub-sector, but also vary greatly between the institutional hosts of research and the funding sources.

Fourthly, because of the circumstances of the two linked projects, this project was not able to say a great deal about participatory livestock trials. There therefore remains important work to be done in reflecting further on analytical techniques that can be used with participatory data, and most importantly in documenting participatory methodologies for on-farm livestock trials from around the world.

⁶ A brief paper by one of the authors (Morton 1997) sets out the views of some major livestock journals on on-farm and participatory research. Editors were generally welcoming of on-farm research, but cautious about research that did not meet “normal” canons of experimental design and statistical rigour. However, few indicated a total refusal to accept papers based on the latter form of research.

As some Tanzanian researchers pointed out, international and regional journals of farming systems, or agricultural social science, which are peer-reviewed, may be a possible outlet for papers on participatory livestock production research.

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A NOTE ON PARTICIPATORY ASPECTS OF NRI/KARI/ILRI RESEARCH ON FARMER FEEDING STRATEGIES

John Morton and Danni Romney

The LPP-funded project "Evaluation and Improvement of Farmer Feeding Strategies for Optimising Feed Intake in Crop/Livestock Systems"¹ was one of the two projects around which the Link project was designed. The project was identified and designed through a combination of participatory rural appraisal and a consideration of researchable gaps in scientific knowledge. After initial PRAs it became a combination of relatively conventional on-station research and a quantitative longitudinal monitoring of farms. Later in its life, the availability of additional financial and human resources allowed the inclusion of participatory agronomic research on maize as fodder, which is reported by Lukuyu (2000), Lukuyu *et al.* (this volume), and further commented on by Paterson (this volume). This brief note fills in the background and progress of the project before the participatory agronomic research was included.

The project, which started in October 1996, was a collaboration between NRI, KARI and ILRI, and stemmed partly from previous work by KARI and ILRI under their programme of "Research and Development to Support Smallholder Dairy Systems to Supply the Nairobi Dairy Market". This work had produced a detailed characterisation of production systems in Kiambu district (Staal, Chege *et al.* 1998) and had made the team aware of the highly variable patterns of feeding dairy cattle.² In the project memorandum this knowledge of local conditions was put in the context of scientific interest in ways of manipulating intake in ruminants. Work was cited on strategies to increase intake of low quality fibrous forages, of which adoption by farmers has generally been low, and also of more diverse strategies practised by farmers to optimise intake and efficiency of nutrient utilisation rather than maximise intake. The planned outputs of the project were to identify factors operating in farmer strategies to control intake, and to develop test and disseminate improved feeding strategies. Planned activities comprised PRAs which would lead to a year-long diagnostic survey or longitudinal monitoring to describe and understand existing feeding practices, and also to on-station trials by a KARI researcher as part of a higher degree at a UK university. Findings from both activities would feed into a programme of participatory on-farm trials.

¹ The authors would like to acknowledge the contribution to this project of Jon Tanner, Bill Thorpe, Peter Thorne and Iscah Sanda, and the institutional support of ILRI and KARI. This publication is an output from research projects funded by the United Kingdom Department for International Development (DFID) for the benefit of developing countries. The views expressed here are not necessarily those of DFID. [R6775 and R6776]

² Particularly by intensive studies of four farms by Iscah Sanda of KARI.

The project started with PRAs carried out by a joint ILRI/KARI/MoA/NRI team. Staal, Chege *et al.* (1998) had analysed data from 176 dairy farms using Principal Cluster and Component Analyses (Staal, Njubi and Thorpe 1998). This exercise identified four main clusters: a wealthy group associated with good representation in formal marketing and community institutions, two groups of the resource-poor associated respectively with involvement in co-operatives and informal milk-marketing, and a small group of specialists associated with low-landholding but high levels of purchased fodder and concentrates.

Individual PRA interviews were carried out in November-December 1996 with 12 farmers, chosen to represent the two resource-poor clusters within Staal *et al.*'s analysis. The PRAs consisted of lengthy semi-structured interviews, including use of visual calendars to discuss feeding practices and labour demands. Topics covered by the PRAs included the following:

- Livestock production objectives of households
- Production plans including breed choice
- Labour bottlenecks
- Management of Napier grass
- Management of maize
- Use of other crop residues and on-farm feeds
- Purchase of fodder
- Purchase and use of concentrate feeds
- Quantities fed
- Frequency of feeding
- Mixing of fodders
- Feed allocation between animals
- Ranking of fodders
- Processing (chopping, soaking, salting)
- Management of manure

In addition, apparent problems in the characterisation study questionnaires for the individual farmers were clarified, and information gathered on daily routines that assisted the practical planning of longitudinal monitoring.

The PRA process had several problems.

- The need to represent all the collaborating research organisations led to very large teams of researchers interviewing single farmers
- The checklists for interview were very long and wide-ranging as they included topics important for other ILRI/KARI research (management of maize and Napier, management of manure) as well as for this particular project. As a result, it was sometimes difficult to probe in detail on any particular topic
- By concentrating solely on individual farmer interviews, the process may have lacked the different dynamic that would have come from discussions with groups of farmers

- The initial idea of using a matrix of feeds used and months, and to rank the feeds, raised certain problems. Farmers (and researchers) were not clear whether they were being asked to compare the importance of a feed across different months, or of different feeds within a month. In the end a compromise was adopted (less cumbersome than it sounds) of comparing green fodders within each month, and concentrate uses between months. Similarly, it was not always clear to farmers if they were ranking fodders in the qualities available to them, or quantity for quantity.

The PRAs generated a great deal of interesting information that helped to define the future course of the project. Apart from the ideas generated for on-station feeding trials (see below), pointers were also given to improve the design of longitudinal monitoring of feeding practices. However, the monitoring of feeding practices funded by the project was only one component of a larger KARI/ILRI monitoring exercise under other funding, and given the complex logistical, data entry and data analysis demands of monitoring, there was limited freedom to incorporate additional elements highlighted by the PRAs. Because of drought conditions, longitudinal monitoring was not initiated until September 1997.

In addition, the PRAs also served to collect useful information that fed into other projects. In particular, findings that farmers generally feed concentrates at a flat rate throughout lactation was important in demonstrating demand for a separate project (Romney *et al.* 2000)

As regards the work on intake, compromises (see also Ashley *et al.* this volume) had to be made between the findings of the PRA, the scientific problems that were central to the original funding applications, and the interests and aptitudes of the researchers put forward by KARI for higher degree placements. The PRAs showed that farmers in the study area, rarely, if ever, have excess feed and therefore, ad libitum feeding is not an option. The original concern with intake manipulation was therefore modified to look at other feeding strategies adopted. While farmer strategies affecting intake had been observed including chopping or soaking stover to optimise intake of unpalatable components, and division of inadequate quantities of forage into portions, spread out over the day, to avoid behavioural problems, it was decided that the most worthwhile contribution would be to investigate short-term changes in feeds. Feed supply varied on a daily as well as a seasonal basis, resulting from opportunistic use of feeds available on and off-farm and from changes in labour patterns (e.g. ill health, social occasions or high labour requirements of other farm tasks preventing the normal collection of fresh forages. It was hypothesised that this negatively affects feed utilisation. A suitable KARI staff member had already been identified to carry out this work. As a result, a series of on-station feeding trials were designed to consider the effects of different patterns of feeding of a fixed quantity of forages of different nutritional quality. The two forages were either fed

singly, changing type every one, five or ten days, or mixed together (at the end of the experimental periods all animals receiving exactly the same quantity of feed on a liveweight basis). These confirmed the hypothesis that alternating the forage offered affected efficiency of utilisation, and further trials investigated the mechanisms involved.

For various reasons, this strand of work did not move forward into on-farm participatory trials as originally planned. However the characterisation studies (Staal, Chege *et al.* 1998), the original PRAs, emerging results of longitudinal monitoring and other activities in the area (Methu 1998) all indicated the maize crop as an important source of fodder throughout the growing season, not just as dry season feed. Modest additional funding became available from the Livestock Production Programme, with NRI contributing some staff time and forfeiting some research fees, and a suitably qualified KARI agronomist was identified to undertake M.Phil research in the agronomy of maize as a forage crop, which included a strong participatory aspect. Additional support covering operational costs came from a bilateral DFID-funded project, the Smallholder Dairy Project, led by the Ministry of Agriculture and Rural Development in collaboration with KARI and ILRI. This is reported by Lukuyu (2000) and Lukuyu *et al.* (this volume).

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A CASE STUDY OF PARTICIPATORY RESEARCH INTO FODDER PRODUCTION FROM MAIZE IN KENYA

B A Lukuyu, R T Paterson, D Romney and S Gündel

Abstract

In the short wet season of 1998 and the long wet season of 1999, a study of dual-purpose maize production for food grain and fodder was conducted in the Kiambu region of Kenya. The first phase consisted of a participatory appraisal of the nature of fodder production from maize. This was followed by a field experimentation phase, where farmers participated in the setting of objectives and managed the trials, which were designed by researchers. The final phase was participatory evaluation of the experiments, leading to the construction of decision trees. This hybrid approach was effective in producing results that were readily adopted by participants, even though it was not fully participatory.

The methodology employed in the current study permitted an understanding, not only of the decisions taken by farmers, but also of the reasons for those decisions that may not have been considered by the researchers. Statistically valid comparisons were obtained between treatments in the field trials, which would probably not have emerged had the design been left entirely to the farmers. In this respect the mixture of formal and participatory work appeared to show benefits that neither approach would have allowed on their own.

The work has clearly demonstrated the need for close involvement of farmers in the whole research cycle. The limited involvement of farmers in the design stage of the field trials contributed to problems during the execution of the experiment. It was felt that thinning regimes were adversely affected, particularly in the first season, because of a combination of practical data collection difficulties, limited researcher availability and complex experimental design. Reasons for such shortcomings may include lack of institutional capacity in participatory research methodologies, time constraints and lack of clarity in the definition of research objectives.

Introduction

Kiambu forms part of the high potential Central Highlands region of Kenya, where soils are relatively deep and fertile, and the bimodal rainfall regime normally allows two cropping seasons per year. Over the past four decades, since independence, farms have been subjected to subdivision to the extent that they are now very small, averaging only 1.1 ha (Staal *et al.*, 1998). The principal cash crops are tea at higher altitude, or coffee below about 1700 m. A range of other crops are produced on a small scale, including maize, beans, root crops, bananas and vegetables. These are intended mainly for home consumption, although in good seasons the excess will be

sold. Most of the farms maintain one or two pure or crossbred dairy cows, usually under zero- or semi-zero-grazing systems, where fodder is cut for them on a daily basis. The system is increasingly reliant on purchased feeds (both fodder and concentrates) and, because of land shortage, there are almost no communal feed resources available in the region, except for roadside grazing. Most of the cattle are of Ayrshire, Friesian, Guernsey or Jersey blood and average milk production is 5.8 kg/day (Staal *et al.*, 1998). Sheep and goats are sometimes kept, generally confined in pens and fed cut fodder, although they are occasionally tethered, either on the farm or on roadsides, to allow them to browse and graze. Inorganic fertilizers are available in the commercial centres, but they are relatively expensive. Animal manure and compost constitute the principal source of additional nutrients for crop production. Livestock are, therefore, an integral part of the production system, since apart from the steady income and cash flow that they generate from the sale of milk, their manure makes a significant contribution to other farm enterprises (Lekasi *et al.*, 1998).

Most farms maintain areas of Napier grass (*Pennisetum purpureum*, or hybrids of *P. purpureum* with *P. glaucum*, formerly known as *P. typhoides*) for the production of cut fodder, but the areas available are seldom sufficient to fully support the existing animal population. Crop residues and weeds removed from the arable areas are fed to the animals, while otherwise unproductive niches such as bunds and terrace risers are planted to a range of species such as Kikuyu grass (*Pennisetum clandestinum*) and Rhodes grass (*Chloris gayana*), or in a few cases to fodder shrubs, including *Calliandra calothyrsus* (Paterson *et al.*, 1998).

On these small, intensively managed farms, meeting the nutritional requirements of high yielding dairy cows is a constant challenge to the farmers, when, even during the rainy season and times of plenty, the amount of feed available was often inadequate (Romney *et al.* 1998). In recent years, attention has turned to obtaining additional fodder from maize, which, apart from the cash crop (tea or coffee) and the Napier grass, usually occupies the next largest proportion of the farm. Previous research has shown that maize can provide animal feed at a number of points in the cropping cycle. High planting densities provide thinnings in the early part of the growth cycle and the opportunity to remove barren plants at a later stage (Methu, 1998); as the plants grow, the bottom leaves can be periodically removed (leaf stripping) (Abate, 1990); after flowering, tassels and upper leaves can be harvested (topping) (Abate *et al.*, 1986); when green cobs are harvested for home consumption or for sale, the green stover remains; and lastly, after the harvest of the dry cobs, the remaining dry stover provides low quality roughage (e.g. Methu *et al.* 1996; Shirima, 1994). However, the project team also knew from PRAs that farmers thin maize for a variety of reasons, trading-off fodder and crop needs in complex ways.

The present paper presents a study conceptualised by Jon Tanner, at that time a scientist at the International Livestock Research (ILRI) and carried out under a DFID Renewable Natural Resources Knowledge Strategy (RNRKS), Livestock Production Programme (LPP) project entitled "Evaluation and Improvement of Feeding

Strategies for Optimising Feed Intake in Crop/Livestock Systems”. The project was led by D Romney, originally of the Natural Resources Institute (NRI), currently at ILRI, and was carried out in Kenya in collaboration with the Kenya Agricultural Research Institute (KARI), the Ministry of Agriculture and Rural Development (MoARD) and ILRI. The study was implemented by Ben Lukuyu who used the results in the preparation of his MPhil. dissertation, which was submitted through the University of Greenwich (Lukuyu, 2000). S Gündel and R Paterson assisted Lukuyu in final preparation of his thesis and Gündel advised Lukuyu on the participatory evaluation exercise taking place after the second season of experiments. Paterson took the lead in preparing the current synthesis.¹

The study involved a combined approach of on-farm and participatory research, which was conducted in the Kiambu region to assess high-density maize planting as an alternative fodder source for cattle under farmers' conditions. The selection of a “hybrid” approach in terms of research methodology (researcher/farmer designed on-farm trial and participatory appraisal) reflects two different research objectives. The first objective was to generate statistically viable data assessing the productivity of the innovation proposed under farmer conditions, ensuring that farmers' views were intimately involved in designing treatments. The second was to develop a better understanding of farmers' decision-making processes of smallholder dairy farmers when managing their maize.

Methodology

The project evaluated in this paper was conducted in three distinct phases as follows (Lukuyu, 2000).

1. Participatory Appraisal: An initial participatory appraisal was carried out across the altitudinal range found in Kiambu District. With the co-operation of local extension staff, two locations were selected in each of three areas, representing the tea/dairy production system (highest altitude); the horticulture/dairy system (medium altitude) and the coffee/dairy production system (lowest altitude). In each production system, one location was represented by an existing interest group (e.g. women's group, self-help group), while in the other, the group was assembled under the guidance of extension officers, specifically for the purposes of the study. Meetings of the individual groups were arranged, where semi-structured interviews were conducted with the aid of a pre-tested check-list of questions, to determine and record current maize and fodder management practices. Participating farmers drew resource maps to represent their farms as they had been in the past (10-20 years ago);

¹ Operational costs of the study were covered under the DFID bilaterally funded Smallholder Dairy Project, which also involves collaboration between KARI/MoARD and ILRI. NRI contributed to Lukuyu's training costs. The authors would also like to acknowledge the help of H Kamani and J Kahero of the Ministry of Agriculture and Rural Development during the research. This publication is an output from research projects funded by the United Kingdom Department for International Development (DFID) for the benefit of developing countries. The views expressed here are not necessarily those of DFID. [R6775 and R6776]

as they were currently; and as they may be in the future, if subdivision continues to reduce the size of farm holdings. Layouts were discussed and key informants were consulted, in order to confirm and clarify the views of the groups.

Seasonal shortage of fodder for dairy cows was identified by all groups as a major limiting factor for farm development and the improvement of family livelihoods. Because of the considerable areas dedicated to the crop (up to 20% of the farm), maize was seen as a possible source of additional fodder. Although it was recognised that in the past, both on-farm and on-station research had been conducted into a number of aspects of fodder production from maize (e.g. Abate *et al.*, 1985; Methu, 1998), the groups agreed that further, on-farm research was required, particularly into the use of high density planting. Possible treatments were suggested and discussed with farmers, following which the groups set criteria for the selection of farms on which the work would be conducted, and volunteer farmers were selected from within each of the groups, to conduct the agreed trials during the second phase of the study. The chosen farms were then visited individually by a team of researchers and extensionists, to confirm that the established criteria were met and to collect initial data.

2. Field Experimentation: The agreed objective of the work was to study the effects of seeding rate and manure application on the production of both fodder for animals and grain for humans, from the same maize crop. Statistically valid experimental field layouts were designed by researchers according to the land allocated by each farmer. A randomised block design was used to accommodate four replications of a 2 x 2 factorial design, where lower seed and fertilizer / manure rates represented normal farmer levels, and higher rates of each factor constituted the test treatments. Final parameters of the treatments were different for experiments conducted at each of six farms. At planting time, the farmer owning the land demonstrated his normal planting practices on the first small plot. Once finished, measurements of spacings and quantities of seeds, manure and fertiliser per hole were taken and replicated in the three other plots designated for the control treatment. Modifications to the seed, manure and fertiliser rates and planting geometry for the remaining treatments were discussed and agreed between the research team, the owner of the land and the group of neighbouring farmers invited to participate. Farmers were, however, helped by members of the research team in the collection of data. The work was carried out in two consecutive cropping seasons; the short wet season (October to December) of 1998, followed by the long wet season (April to July) of 1999.

During the first season, it became obvious that some of the participants did not thin as they might have done under normal conditions, being inhibited in thinning by the requirement to make arrangements with the research team to assist in data collection. With the experimental spatial layout, and the conventional experimental practice of leaving guard rows, it was not easy for farmers to take measurements themselves. Therefore they always made arrangements for the research team to be present when thinning was to take place. Although every attempt to accommodate

farmers wishes was made, farmers often thin little and often (as was observed in the second season) and it was impossible for the research team to be present every day.

In the second season, in an attempt to overcome this problem farmers were offered the option to use a simplified design, employing only their normal seed and manure treatment as a control, together with a second treatment, of high seed and low manure. This option omitted the high seed/high manure, and the low seed /high manure treatments included in the original design.. Both treatments were sown only as single plots, which were divided into five, in order to provide some estimate of variability, and there was no use of guard rows. One of the six farmers chose to plant only the simple design, while another planted both trials. These farmers were given scales and record books and took their own records, thinning as and when they wanted. The other four farmers continued with the original design. In all cases, the variables measured included yield of maize fodder from thinnings, green stover (after harvest of green cobs) and dry stover (after normal grain harvest); yield of weeds which could be fed to livestock; and yield of grain from maize and, where appropriate, from intercropped beans. Chemical analyses of samples of each fodder component provided an estimate of their feeding values at the time of harvest.

3. Participatory evaluation: Participatory evaluations were conducted at all trial sites at the end of each season, at the time of final harvest. Firstly, the collaborating trial farmers were interviewed alone, in order to record their personal observations and opinions. These sessions included a resource-mapping exercise and a farm walk. Following this, group interviews were conducted with the neighbours around each trial site, during which the trial farmers were asked to reserve their interventions until the end of the session, so as not to unduly influence the group discussions. As in the initial appraisal, a pre-tested checklist of questions was used to guide the discussions. During both group and individual sessions additional information was collected on normal maize management techniques; the reasons for making weeding, harvesting and management decisions regarding the crop; and individual and group opinions regarding the execution and efficiency of the trials. Suggestions for future treatment modifications were also recorded during the course of the discussions following the first season of experiments.

Major Research Findings

The major technical findings of the research were as follows (Lukuyu, 2000). Increased plant density led to increased cob numbers and decreased cob size. This generally resulted in stable grain yields, except where delayed thinning and lack of rain led to poorer grain productivity. Farmers were willing to risk this reduction, since they were confident of obtaining increased fodder yields from higher plant densities. Manure and fertiliser had little effect on the fodder or grain yield, although it might be expected that in the long term, increased offtake would result in nutrient mining of the soil, which would ultimately have a negative effect on productivity. The scope for increased manure use on the maize crop was limited by

availability, while fertilizers were relatively expensive. Nevertheless, farmers showed a willingness to apply nutrients to the crop, because they felt that this would lead to increased yields of fodder as a by-product of grain production. In two cropping seasons during the year, the area of maize on the average farm (0.17 ha) could yield sufficient fodder as thinnings, leaf stripping, green stover and dry stover, to provide a maintenance diet for two typical dairy cows for from 1.0 to 2.4 months of the year. Almost all farms have animals, and there is also a ready market for both green and dry maize plants, so all farmers are in a position to take advantage of the fodder produced by the maize. The existence of maize fodder reduced the pressure on Napier grass at critical times of the year. This is the primary source of animal feed and improved management practices resulted in more fodder production. The maize crop therefore makes an important contribution to animal production within the Kiambu farming system.

The Participatory Process

As mentioned earlier the research process consisted of a “hybrid” approach in terms of research methodology. This had an impact on the participatory nature of the study, as farmers' participation was not achieved throughout the complete research cycle. Using Biggs (1989) classification scheme of participatory research, the present project would rank between a consultative and collaborative mode of participation.

The experimentation phase of the research process was based on a participatory appraisal taking into account farmers perceptions and needs. Experimental treatments were designed together with farmers, with farmers on individual farms having the final say on crop geometry, rates of seed, manure and fertiliser and subsequent management practices. However, the experimental plot layout was established by the researcher with the objective to obtain biophysical data that could be readily subjected to statistical analysis. This objective was probably not shared by the farmers involved, which had in turn implications in terms of ownership of the trial and subsequently monitoring and evaluation efforts (Gündel 1999). However, in general farmers were interested in the underlying research question and they managed the trials in close collaboration with the research team. At the end of the cropping season farmers contributed to the evaluation procedure by sharing their qualitative observations with the research team, which revealed the complexity of their decision-making processes in crop management.

Outcomes and issues raised

The methodology of the current study could be described as "hybrid". The layout of the trials was designed by researchers in accordance with standard experimental practice, while farmers designed and adapted their own treatments. For highly specific reasons connected with data collection and researcher availability, farmers

still felt inhibited in their management of the crop during the first season, but a further simplification of trial design reduced this problem in the second year.

This hybrid methodology permitted an understanding, not only of the decisions taken by farmers, but also of the reasons for those decisions that may not have been considered by the researchers. For example, when the rains largely failed in a particularly poor wet season, a high proportion of maize plants were barren, failing to produce cobs because of moisture stress. The whole crop was then harvested as green stover for feeding to livestock, since the salvage value of the fodder was considered to be higher than the potential returns from a poor stand of maize harvested as grain.

The work showed that, while manure is a scarce resource within the small-scale, mixed farming sector, producers are prepared to devote a large proportion of it to their maize, in the belief that it will increase the availability of fodder at times when the Napier grass alone cannot support the animal population. Farmers find that it is cheaper to buy maize grain to feed the family than to purchase fodder for their animals, so if necessary, they may be prepared to forego grain production in order to ensure adequate feed supplies for dairy cows. Furthermore, the direct involvement of the farmers led to rapid adoption of high seeding rates for maize, in order to increase the production of thinnings for fodder.

The information generated in the present study was used to construct decision trees and gain insights into the dual-purpose maize crop, which would not have been possible with a more conventional research approach. On the other hand, statistically valid comparisons were obtained between treatments in the field trials, which would probably not have emerged had the design been left entirely to the farmers (although it was felt that the data in the second, "more participatory", season, was less reliable than that from the first). In this respect the mixture of formal and participatory work appeared to show benefits that neither approach would have allowed on their own.

Conclusions and implications

The work has clearly demonstrated the need for close involvement of farmers in the whole research cycle. In the present study, the limited involvement of farmers in the design stage of the field trials led to problems during the execution of the experiment. It was felt that thinning regimes were adversely affected, particularly in the first season, because of a combination of practical data collection difficulties, limited researcher availability and complex experimental design.

The present study was able to fulfil participatory and scientific objectives by evolving over two seasons. If a research study aims at obtaining statistically valid results which will contribute to an understanding of biological processes whilst at the same time testing and adapting an innovation under farmers conditions, an alternative might be to establish a farmer-led trial alongside a researcher designed

trial.. This compromise would be able to accommodate the divergent, but complementary requirements of all partners in the research process, leading to better and more appropriate results.

Reasons for limits on the involvement of farmers in the whole research cycle may include lack of institutional capacity in participatory research methodologies, time constraints and lack of clarity in the definition of research objectives. Research institutions and donor organisations have to be aware that successful participatory research requires trained staff and a clear research agenda, which justifies the selection of such a research approach.

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SOME REFLECTIONS ON PARTICIPATORY RESEARCH, WITH PARTICULAR REFERENCE TO A CASE STUDY OF FODDER PRODUCTION FROM MAIZE IN KENYA

R T Paterson

A companion paper in this volume (Lukuyu *et al.*) presents a case study of participatory research into the production of fodder from maize in the Central Highlands region of Kenya. Even though the work described is considered to be an imperfect example of the application of participatory research, the paper rightly concludes that the technique has demonstrated considerable value in the execution of a programme of agricultural research and dissemination. The present author fully subscribes to this sentiment and the following reflections, based on an assessment of the project and supplemented where necessary by personal experience in both Africa and South America, are in no way intended to dispute the conclusion. They are, however, intended to draw attention to some of the limitations of participatory work and to issues which developing world institutions need to consider before undertaking work along these lines.¹

The Participatory Process

The research process as employed in the companion case study (Lukuyu *et al.*, 2001) and explained in detail by Lukuyu *et al.* (2001) did not completely follow the emerging participatory theory (e.g. Sutherland 1998), although it was firmly rooted in the participatory approach, since it used both an initial participatory appraisal and also a final participatory evaluation. The objectives and treatments used were based on farmer perceptions and desires, but the field trials were designed by researchers, using accepted scientific principles, in order to generate data that could be readily subjected to statistical analysis. The farmers managed the trials, but it appears that at least some of them either failed to fully understand the treatments or had difficulty in implementing them, although this probably had more to do with the application of the approach than to its intrinsic shortcomings. The resultant, hybrid methodology fell between conventional research and full participation, tending towards the collegiate end of the scale. The following comments need to be considered in the light of this limitation.

1. Potential benefits: The methodology employed in the study under discussion permitted an understanding, not only of the decisions taken by farmers, but also of the reasons for those decisions. For example, when the rains largely failed in a particularly poor wet season, a high proportion of maize plants were barren, failing to produce cobs because of moisture stress. The whole crop was then harvested as green stover for feeding to livestock, since the farmers reasoned that the salvage value of the fodder would be higher than the potential returns from a poor

¹ This publication is an output from a research project funded by the United Kingdom Department for International Development (DFID) for the benefit of developing countries. The views expressed here are not necessarily those of DFID. [R6776]

stand of maize harvested as grain. From the information generated in the study under consideration, decision trees for the dual-purpose maize crop could be constructed, which would not have been possible with a more conventional research approach. On the other hand, statistically valid comparisons were obtained between treatments in the field trials. Given the relatively small number of farms involved in the work, this would not have been possible if the design had been left entirely to the farmers. The mixture of formal and participatory work appeared to show benefits that neither approach would have allowed on their own.

Farmers were actively involved in the whole process, from the time of inception through to completion of the final evaluation. They considered the project in its entirety, taking into account aspects that may not have been immediately obvious to the researchers. The work showed that, while manure is a scarce resource within the small-scale, mixed farming sector, producers were prepared to devote a large proportion of it to their maize, in the belief that it would increase the availability of fodder at times when the Napier grass alone could not support the animal population. Farmers find that it is cheaper to buy maize grain to feed the family than to purchase fodder for their animals, so if necessary, they are prepared to forego grain production in order to ensure adequate feed supplies for dairy cows. Furthermore, the direct involvement of the farmers led to rapid adoption of high seeding rates for maize, in order to increase the production of thinnings for fodder. Within the communities where the work was conducted, extension efforts to promote the technique would not, therefore, be necessary, even though they would clearly be needed to ensure the spread to other locations in the same region.

One of the perceived benefits of participatory research in general is that it allows, and even encourages farmers to adapt treatments according to their own requirements and experiences (eg Sutherland 1998). In the Kenya study, while farmers had control over management practices, radical changes to the experimental design during the course of the work were not permitted, since this would have affected the validity of the statistical comparisons. As a result of this limitation, the case study describes a hybrid exercise, rather than a fully participatory project. Nevertheless, farmers determined the original objectives of the field trials and were able to gain experience in production techniques, which could be explored at a later date, either alone or in continued collaboration with extensionists and researchers.

2. Potential problems: The work clearly demonstrated the need for simplicity in field trials, where active participation by scientifically unsophisticated farmers is a prerequisite. In the case study, it was felt that thinning regimes were adversely affected, particularly in the first season, because the farmers were inhibited, either by the complexity of the experimental design, or by the complicated nature of the sampling regime. This was so, even though the trial consisted only of four replications of four treatments at each site, which could be considered as the minimum number of plots required to produce statistically valid results from a small number of trial sites. Surprisingly, in the present study, when given the opportunity to use a simplified design in the second season, only one of the farmers chose to

completely abandon the technical design. No rational explanation for this apparent contradiction emerged, but the fact remains that simplicity of design appears to be crucial in participatory, on-farm work. This point was highlighted in a dairy study in the Embu region of Kenya, where small-scale farmers employing similar production systems were easily able to understand experiments where either two, or three rations were fed consecutively to milking cows in a cross-over design (Paterson *et al.*, 1999). For studies with fodder or field crops, where comparisons between a larger number of treatments may be needed, it may be advantageous to plant a simple trial, designed by farmers, alongside a more technically demanding, supplementary experiment, scientifically designed by researchers after detailed discussions with the collaborating farmers. This compromise would be able to accommodate treatments that farmers may want to include, but which technical staff consider to be unnecessary. Although such a step would increase the requirements for land and labour, it may be able to satisfy the divergent, but complementary requirements of all partners in the research process, so leading to better and more appropriate results.

Some recent trends and suggestions, particularly from aid donors, seem to imply that participatory research should almost totally replace more conventional, scientific studies in activities conducted for the benefit of poor farmers. This rather extreme view would appear to ignore the different objectives of the two approaches, which should not be seen as competitive, but rather as complementary, in the same way that basic, adaptive and applied research are accepted as part of the same investigative continuum. Technical studies are generally designed to produce statistically valid results which will contribute to an understanding of biological processes and which will permit a degree of geographic extrapolation and scientific inference. This requires a suitable level of control and standardisation, to minimise the confounding effects of non-experimental variables. In contrast, farmers are largely concerned with their own situation and therefore have less interest in, and need for statistical validity. The necessary simplicity of participatory designs will usually preclude the possibility of extrapolation, even though the inclusion of the final beneficiaries in the research process should allow them to adapt techniques to suit their own, unique situations.

The above comments should not be taken to imply that participatory research is an easy option where scientific principles may be afforded a low priority. It is axiomatic that poor research will always produce poor results, no matter what argument is used to justify a lowering of professional standards. Indeed, as far as possible, the same scientific rigour should be applied to both fully participatory and to researcher-managed trials, with the only difference that the design of the former should be kept as simple as possible, to provide participating farmers with a clear demonstration of the differences between treatments. If management practices are kept relatively standard across farms, and if enough sites are included, researchers working with the farmers should be able to conduct an analysis of the results pooled across sites, in order to estimate the statistical validity of the results. In most cases, however, the provision of an adequate number of trial sites will demand a large and

expensive research programme, which may be beyond both the physical capability of national institutes in developing countries and the funding capacity of aid donors.

It should be clearly understood that participatory research is often more demanding in terms of resources than conventional investigations, because of the increased number and length of visits that technical staff need to pay to farmers to ensure their continued collaboration and enthusiasm. It also demands a heavy commitment of time on the part of the farming family. In the Kenya study, the research team included both extension and research staff, thereby requiring close collaboration between different government entities. Where increased numbers of staff are involved in a single project, other activities may have to be foregone, or given a lower priority. There is obviously a trade-off between the added efficiency of participatory work on a given subject and the number of other activities that are affected by it. It seems unlikely that useful generalisations can be made regarding this matter, and consequent research management decisions will have to be taken on a case-by-case basis. It is, however, something that needs to be carefully considered at the inception stage of any participatory project.

Institutional implications

The adoption of participatory techniques has a number of implications that should be of concern to both local and international organisations.

Aid donors have spoken for years about the need for research and development to be demand-led, rather than donor-driven. In recent times, however, it appears to have become accepted wisdom amongst the donor community that research in rural development should be both participatory and innovative, almost irrespective of the nature of the work to be undertaken. The contradictions inherent in this attitude need to be exposed. There is considerable danger involved in attempting to design and implement an innovative and untried research programme to address a topic that is obviously amenable to a conventional approach. Similarly, not all subjects (eg. vaccine development) lend themselves to fully participatory techniques. Participation should be seen for what it is: a useful approach that uses a selection of relatively new tools to address points of direct interest and relevance to a specific farming community with a well-defined production system. Clearly, farmer opinion should be taken into account in the design of applied, agricultural research projects, since they are expected to be the ultimate users and beneficiaries of the work. Nevertheless, despite generations of empirical observation, farmer perceptions and indigenous 'knowledge' can sometimes be far removed from the scientific truth. As an example of this, even educated people in the Embu region of Kenya insist that malaria results from eating too many mangoes. While there may well be a demonstrable correlation between the mango season and the presence of infected mosquitoes in the area, the relationship is coincidental, rather than causative. A sympathetic approach should always be shown to indigenous knowledge, but the

stated beliefs of farmers must be interpreted with care, before being incorporated into a programme of work which will be both costly and time consuming.

Participation is sometimes, mistakenly, seen as a way to reduce the institutional costs of agricultural research and extension, by spreading the financial load between the different partners. In many instances, the small-scale farming sector is least able to bear the cost of a contribution to the research process. Even in cases where farmers are willing to supply the land and provide much of the labour for the work, participatory research should not be seen as a cheap option, since, to be effective, it requires a large and experienced research team, including both biological and social scientists, who are willing and able to work closely with the farmers. The logistical and organisational costs of mobilising such a multi-disciplinary team will usually far out-weigh any savings on operational expenses. Where appropriate, the use of participatory methodologies should be justified on the grounds of increased efficiency and adoptability of the results, rather than as a way to reduce the cost of agricultural research.

The commitment of a research institute to participatory research is not to be taken lightly. The procedures are still evolving in the light of hard-earned field experiences, but they are unfamiliar to many practising, traditional scientists, particularly in the developing world. Formal training in participatory techniques may often be necessary before undertaking these activities. Ideally, this should include a period of practical, field experience to reinforce theoretical sessions. In the case of the Kenya study, no initial training was provided, with the result that project staff had to learn the processes during the course of their field activities. Prior training may have made it easier to avoid some of the difficulties that were encountered along the way.

The direct involvement of technically unsophisticated farmers in the research process may potentially have a negative impact on the replicability and scientific quality of the data that emerge from the process. If allowed to reduce the scientific rigour of the work, full farmer participation can reduce the validity of the conclusions. There are new methods available to analyse incomplete, anecdotal and qualitative data, but, given the reliance which quality scientific journals still place on formal and familiar statistical tools, publication of the results can be difficult (Pound *et al.* 1999). This can have negative implications for the practitioners, particularly if they are in the early stages of their professional careers. The individual scientist and his institution will have to evaluate this effect, since personal advancement and institutional funding opportunities are often related to the number of publications appearing in quality, peer-reviewed journals.

Recipients of aid should be prepared to critically examine the agendas of the traditional donors. New ideas and fashions in agricultural research should not be accepted blindly, unless there are likely to be clear advantages for the developing region. While it may not be easy to reject an offer of funding, this step should be considered as a last resort, if the proposal for financial support is likely to lead a

receiving institution in a direction that is incompatible with its own necessities and commitments.

Conclusions

The potential usefulness of the participatory research methodology is not in doubt, particularly where farmer adaptation of new techniques is thought to be necessary in order to ensure subsequent adoption. It should be seen, however, as one component in a whole range of research tools, to be employed as required, for specific purposes. The temptation to see it as a panacea to solve all of the problems of the developing world needs to be resisted, since inappropriate application will only lead to disappointment and a loss of confidence in the general validity of the technique.

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**Evaluation of Farmer-
Participatory
Approaches to
Livestock Production
Research**

**Compromise and
Challenges: the
Process of
Participatory
Livestock Research
in Tanzania**

S.D. Ashley
S.J. Holden
N.F. Massawe
E. Owen
L. Mtenga
D.L. Romney

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In Development Ltd
P.O.Box 20, Crewkerne
Somerset, TA18 7YW, UK
Tel: +44 (0)1460 74 874
Fax: +44 (0)1460 75 874
E-mail:
Lid@Compuserve.Com

Contents

Main Report

1. Introduction	Page 1
2. The Research Process	Page 1
The initial fieldwork phase (step 2)	Page 3
Reviewing the findings (steps 3 and 4)	Page 4
3. Research Methods and Rationale	Page 5
4. Lessons, Issues and Questions	Page 6
The need for participatory approaches	Page 7
The fundamental need to understand.....	Page 7
From science to social science	Page 9
Research as a compromise	Page 9
Challenges for animal science	Page 10
The limits of economics	Page 10
Problems with research and extension	Page 11
The wider context matters more	Page 11
5. Conclusions: Implications for Farmer Participation in Livestock Production	
Research	Page 14
The institutional environment for research	Page 14
Animal production and development	Page 16
References	Page 17

Annexes

Annex 1: Methods used and reasons	Page 18
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Compromise and Challenges: the Process of Participatory Livestock Research in Tanzania

1. Introduction

Between 1996 and 1999 the Livestock Production Programme (LPP) of the DFID Renewable Natural Resources Knowledge Strategy (RNRKS)¹ funded a research project 'Husbandry strategies for improving the sustainable utilisation of forages to increase profitable milk production on Tanzanian smallholder farms'.

The project aimed to ensure that the animal production research conducted addressed the constraints of smallholders in Tanzania, and would therefore be able to lead to appropriate extension messages. This was felt to be important because of the observation that few of the technologies produced from animal production research had been adopted by small-scale livestock-keepers in Tanzania, and the associated widespread feeling that this is largely due to research which was not based on an understanding of its clients' needs.

The principle investigator – Nicholas Massawe – was a staff member of the Selian Agricultural Research Institute (SARI) in Arusha Tanzania, and was conducting the research in pursuit of a PhD at Reading University, UK. He was jointly supervised by professors at Reading and at Sokoine University of Agriculture (SUA) in Morogoro, Tanzania. In addition, Mr (now Dr) Massawe was supported by specific animal science research expertise provided through Natural Resources Institute (NRI) of the UK, and by socio-economic expertise provided by Livestock In Development (LID), also of the UK.

This project has now closed, and resulted in a number of interesting outputs and research findings, plus a successfully completed PhD for the principle investigator. The technical findings from this project are reported in the PhD thesis itself (Massawe 1999), plus also in the project's Final Technical Report to LPP (Massawe et al 2000). A selection of socio-economic issues are discussed in Ashley et al (2000).

This paper steps back from the detail of the project and reflects on wider lessons for this kind of research in future. It first reflects on the process followed in undertaking the research, on the key decisions made and on the pressures which led to them. It then considers the importance of the methods used to the outcome of the research, in particular its ability and need to disaggregate the notion of 'smallholders' and therefore to see diversity where it existed. This leads to a discussion of lessons learned through this project about the introduction of a participatory research approach in which social and economic issues are given due attention. Finally some wider conclusions are drawn and further questions asked about the implications of this analysis for the discipline of animal production in a poverty-focused development context.

2. The Research Process

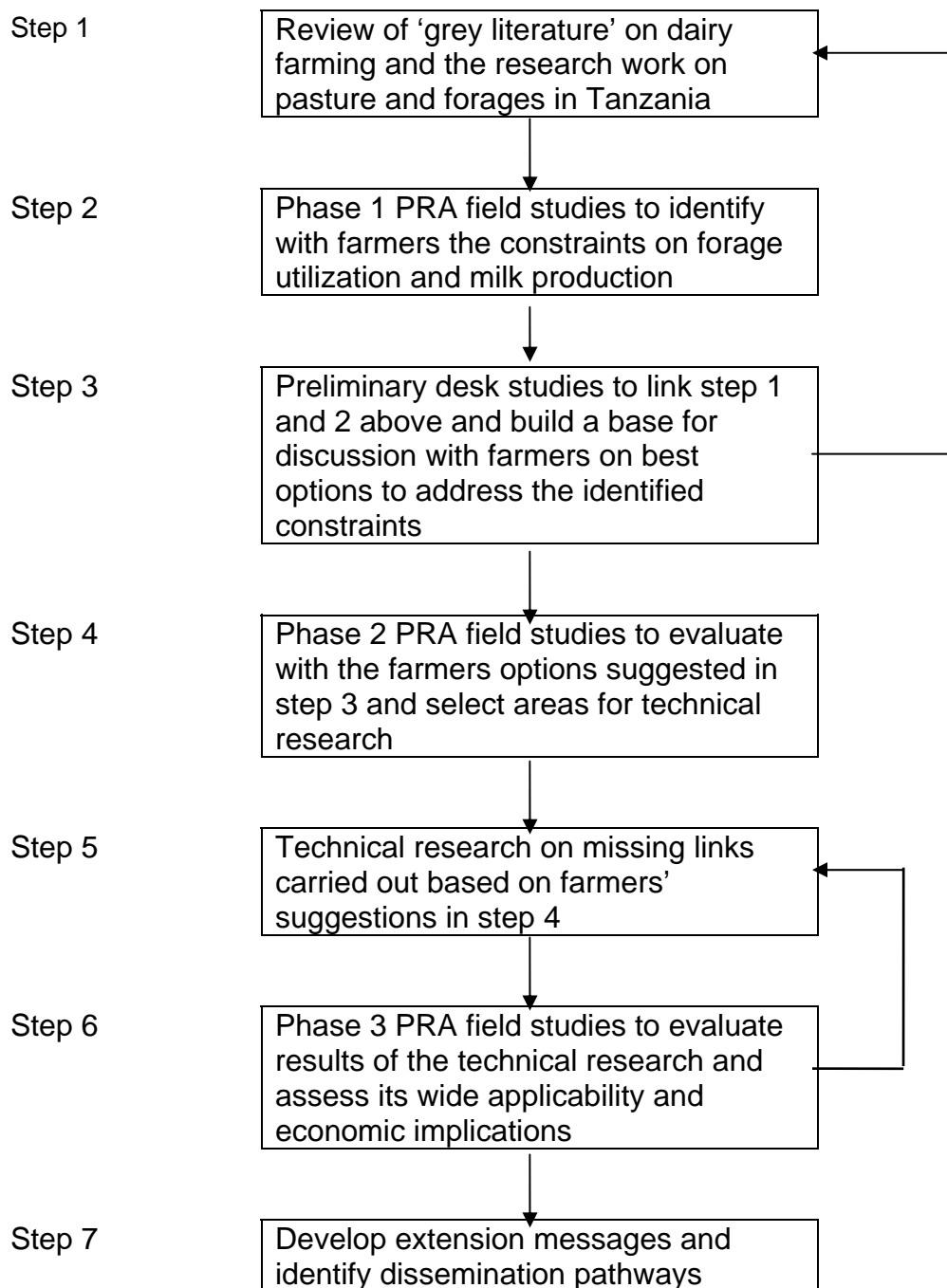
The subject of research for animal production PhDs is usually selected based on an understanding of recent research findings and interesting issues which emerge from these. The project departed significantly from this norm, by deciding that the research questions it would address were not known at the outset, and would only become known later as an understanding of specific livestock-keepers' problems were identified. None of the scientists

¹ When this research was initiated, DFID was still known as ODA, and the RNRKS was known as RNRRS, in which the final 'R' stood for research.

from SARI, Reading, Sokoine or NRI had previously been involved in such an approach. The objective of the LID input was therefore to support this element and to ensure good practice was followed in the participatory process that was pursued.

The research followed a 7-step plan which broadly identified what was known already, investigated current problems experienced by milk producing livestock-keepers in Tanzania, returned to the literature to search for potential solutions, returned to farmers to discuss the appropriateness of these solutions, identified 'missing links' which could be the focus for new research, conducted the research, and disseminated the results. This process is captured in figure 1, and is described in more detail in the thesis resulting from this work.

Figure 1. Outline of the steps involved in the research process.



Source: Massawe et al (2000).

However, this is not to say that the study had total freedom to choose its own agenda, since a number of constraining commitments were made in the project proposal:

- it was to focus on milk production rather than other aspects of animal production such as draught power, animal offtake or manure;
- it was to be concerned with feeding, and particularly forages, rather than other livestock problems which might emerge;
- it needed to focus on 'smallholders' rather than commercial enterprises, and this was taken to mean that civil servants and business-people who keep livestock were excluded;
- it needed to accommodate the needs for an animal production PhD as well as provide developmentally-relevant research;
- it had limited resources, especially researcher fieldwork time and transport.

As such the research was not driven by farmer needs in a pure sense since researchers arrived in villages with their own research agenda, which they would have been obliged to pursue even if livestock-keepers had declared that this was not the most important issue for them to be diverting resources to (as indeed happened in some places).

Nevertheless within these limits the study retained considerable flexibility to determine its own direction. In doing so it made significant choices at several points in which it deviated from expectations, in pursuit of issues of relevance to its livestock-keeping clients. Given the background presented above it also had little choice but to make several important compromises. These occurred during step two of the research process described in figure 1, and again during steps three and four, and are discussed in the two sub-sections below.

The initial fieldwork phase (step 2)

The approach to this phase of the fieldwork was to start with a broad perspective, gradually building up a picture of understanding and then refining the focus of discussions towards problems encountered and possible solutions, until a number of researchable issues had been identified in collaboration with milk-producing livestock-keepers. In this way, the process became more farmer-centred, and the likelihood of the research being targeted to real and priority constraints was increased. This approach also increased the likelihood of researchable issues taking into account peoples' opportunities and constraints, so that feasible and appropriate suggestions could be produced by the researchers.

The work was conducted in three sites in Tanzania. Kilimanjaro was chosen because it was close to SARI and was known to be one of the major milk producing areas of Tanzania, Morogoro was chosen because it has received considerable input to dairy goat development through SUA and was therefore of interest there, and Mwanza was chosen because it was one of the two areas prioritised for British Aid support under the country strategy then being pursued by DFID Tanzania, and also because it had an agro-pastoral livestock system not commonly focused on by animal productionists interested in dairying.

The idea was to select specific villages and to then learn about the problems in those villages. However this introduced difficulties, particularly around the different village selection decisions which could be made depending on understandings of the term 'smallholders', and the implications such decisions would have for the kind of research the project would be likely to conduct.

The most obvious milk production system in the Mwanza area is the semi-intensive dairying which had recently developed spontaneously in urban and peri-urban areas (Nyamrunda and Sumberg, 1998). At the time of the fieldwork, the World Food Programme had an

ongoing project aimed at introducing similar systems based on crossbred exotic animals to villages in districts around Lake Victoria. Simultaneously however there is a much larger (in terms of numbers of people) system producing milk for sale from extensively reared local cattle. The team decided it needed to choose between the two systems as the focus for identification of farmer constraints, since resources determined that both could not be accommodated to a sufficient depth of understanding.

Preliminary investigation of these two systems revealed that the semi-intensive system was in fact mainly practised by civil servants living in town-like nodal villages, and that the extensive system was more widely practised throughout the rural areas. Both could nevertheless be conceived as 'smallholders'. From a technical feeding strategies perspective, the semi-intensive system was a better choice since extensive livestock-keepers showed little interest in the issue of forage utilisation. However from a poverty and extension perspective, the semi-intensive system was of limited interest because of the relative wealth of the people involved and their small number.

In the end the team decided to interpret the smallholder clients of this research as meaning 'the relatively poor' and 'the kind of livestock-keepers normally excluded when such factors are not explicitly accounted for'. As a result the focus was placed squarely on the extensive system, although it was known that this would be more difficult. This was the first 'pro-poor' decision taken by the project, and its first opportunity to depart from early expectations of what it would do.

Reviewing the findings (steps 3 and 4)

The understanding of constraints gained through step two was followed by a return to the literature to identify existing experience which might be useful in addressing those constraints. Possible solutions were then taken back to livestock-keepers to review for appropriateness, and to consider possible areas which might be investigated through further research.

The team was surprised to find that the animal production feeding strategies literature presented few feasible options which had been tested and found to be appropriate for livestock-keepers in similar contexts elsewhere who experienced similar problems. Much of the research was based on-station and therefore did not include the kinds of practical issues revealed to be important in Kilimanjaro, most of it was not problem-solving in its approach, much of it ignored system linkages in its prescriptions, and little of it applied economic or other social analysis.

For example in Mwanza the team concluded that the extensive milk system had been neglected in the literature and that we therefore really had little to offer in terms of potential pre-existing technical solutions to problems there, or through any research programme this project could feasibly undertake.

In Morogoro it was concluded that the literature and associated technologies were based on scientists' assessments of the problems rather than those of the farmers and was therefore of little use. As a result there was little evidence of uptake of previous research findings, probably because farmers did not perceive any advantage in the so-called 'improvements'.

It might be expected that this would leave plenty of 'missing links' for the project to pursue and that it might have therefore been relatively easy to choose the technical research that was to be conducted by the project. However this did not prove to be the case, with difficulties arising on three questions:

- Where the research should be focused;
- What question to address; and

- How to address it.

Research Location. The question of where to focus the research revealed conflicts of objectives. From a poverty perspective, Mwanza would have been chosen. However, the fieldwork in step 2 had revealed that the milk production systems chosen were in fact extensive cattle rearing systems in which milk was one of several outputs, and not the most important of these. This did not fit easily with preconceptions of what the research should be about. More importantly, it also did not provide obvious entry points for technical animal production research, because of the complexity of the issues within a communal grazing system which required correspondingly diverse responses which were felt to be beyond the study resources.

Morogoro might have been chosen, except it became clear that there was only a relatively small population who had dairy goats, so this would have limited the applicability of any research and extension findings and therefore compromised the development objectives of the research. So, Kilimanjaro was chosen even though it is generally considered to be one of the wealthiest parts of Tanzania.

This was perhaps the moment when the least pro-poor decision was taken, but the project had little choice given the predetermined milk-forage research agenda, the limited resources, and the need to deliver PhD level research findings.

Research question. The question of what to research in Kilimanjaro gave the team similar problems. On the one hand we had said we wanted to research issues which were of most concern to smallholder farmers, but on the other we needed to make sure that research of a particular type was conducted so as to ensure sufficient material was produced for an animal production PhD at Reading. A further complicating factor was the limited resources and timing which in practice circumscribed the research options.

At this stage the research almost departed from its objectives, and the team seriously considered prioritising the PhD criterion above the farmers' needs criterion. After lengthy discussion of options, a compromise was found which aimed to address farmers' needs in Kilimanjaro and which was felt likely to provide sufficiently robust technical research for a PhD. This comprised applied research on manual box-baling of maize stover, which was found to reduce the cost of feeding dairy cows. The cost of forage had been identified through the participatory approach to be one of the greatest problems faced by many livestock-keepers in Kilimanjaro, especially the less well-off.

Research method. Overlapping with the discussion of research question was a debate on whether the research identified should be carried out on-farm or on-station. Once more this was largely centred around the conflict of getting good enough data for a science PhD, compared with conducting research which would be relevant to farmers and would also allow us to base extension messages on our findings.

The experience of the literature review, in which it became clear that much on-station research had little relevance to farmers' realities, made the team wary of working on-station ourselves, given the wider objective of the project to lead to extension messages. On the other hand it was felt that on-farm research, especially if it was to involve animal measurements, was more risky and could result in poor quality data which might not support a PhD.

Again this was eventually resolved with a mixture of both approaches, with an attempt to go beyond research into farmer testing and extension.

3. Research Methods and Rationale

Figure 1 showed how the research process followed was broadly participatory in that it identified problems with livestock-keepers, reviewed some ideas for solutions with them, and decided again with them what further research should be conducted. It then became a mixture of a participatory and researcher-led process, in that some research was conducted with farmers in the field, and other parts of it were conducted by the researcher on-station. This process would probably fit into the category of a 'collaborative' research style – which is towards the more participatory end of the spectrum – according to the Biggs schema reported in Morton (2000). However as has been discussed above, this process was by no means pure, and involved compromise and the balancing of competing factors all the way.

Different methods were used at each of these stages. The participatory learning methods used with different stakeholders while understanding livestock-keeping systems and the variety of problems faced regarding feeding for milk production have been described in Ashley (1997) from which the table in annex 1 is reproduced.

Subsequent stages of the research used a mixture of formal and informal research methods, including scientific assessment in step 5, a further selection of diagramming tools such as decision trees and problem trees, and methods designed to enhance livestock-keeper learning including farmer-to-farmer visits.

The study therefore used a variety of research methods, each of which was chosen to be most appropriate for the required use.

A number of points emerge from this brief description. First, the methods used, and the ways in which they were combined, were unusual in that they would not normally be a part of academic livestock research. This was required in order to ensure the research focused on resource-poor livestock-keepers.

Second, it was some time before the team became sufficiently familiar with the approach used to move beyond the simplistic notion that participatory research methods are just a case of asking farmers what they think and writing down the answers. This is a common phenomenon experienced by social scientists working with natural scientists for whom their methods are new. Instead the project was meticulous in ensuring that its use of methods led to reliable findings, for example through use of informant stratification and disaggregation, the process of cumulative building up of understanding, and through triangulation and cross-testing of key issues. Rather than these aspects being neglected because this was a small study, they were emphasised precisely because of the limited resources which meant that samples were small.

Third, disaggregation of livestock-keepers was central to the approach adopted by the project, whereas it is normally not featured at all in much livestock research. As such this is a key distinction between the people-centred approach adopted here and animal- or product-focused approaches which tend to predominate. As discussed earlier, the methods used here reflect that this project actively chose to prioritise the problems experienced by the relatively poor, though not without compromise on the way.

4. Lessons, Issues and Questions

This section discusses some of the specific issues which emerged and lessons which were learned whilst going through the research process described above.

The need for participatory approaches

The work conducted under this project allowed us to see clearly the advantage of using a participatory research approach.

The participatory understanding of livestock systems revealed that different livestock-keepers practising the same livestock systems have different constraints, different opportunities, and adopt different strategies to fulfil their differing objectives. This is an important realisation for animal production scientists who tend to look at livestock systems rather than the people who practice them.

Therefore if we want to find appropriate solutions to farmers problems, we have no choice but to understand the nature of those problems, and differences between them, first. Where this is an objective, participatory research (or at least research based on a good understanding of livestock-keepers problems and objectives) is not just an option but a necessity.

The lesson here is that technology cannot be developed in isolation from the livestock-keepers who are meant to use it. This is particularly the case for risk-averse relatively poor livestock-keepers, but this realisation has not been widely incorporated into the way livestock technology is developed. The result is the lack of relevant and appropriate technologies found during this study.

A participatory 'farmer first' (Chambers et al, 1989) approach involves understanding these differences so that they may be acted upon. This is an important departure from approaches commonly adopted by livestock professionals in which 'sectoral' constraints are identified, and lead to attempts to address those sectoral constraints. This project revealed that the problem with the latter approach is that the sectoral constraints do not acknowledge the differences between livestock-keepers, nor do they necessarily address the actual problems that farmers face. For example it is widely quoted that poor nutrition is the main reason for low milk production in developing countries, but rarely is there any analysis of why this is the case (Massawe et al, 2000). This study has shown that the answer to questions such as these for individual households is frequently not technical in nature and is instead complex and related to combinations of social and economic factors.

Therefore an approach which addresses sectoral constraints (for example fodder, water, housing etc) may not address the real problems felt by poor livestock-keepers in particular, which may have nothing to do with technical livestock problems but may be more related to issues such as lack of access to land, cash, markets or credit, or insecure tenure over grazing. Under these circumstances, sectoral interventions may not change anything in practice for individual livestock-keepers – especially the poor – even if the main sectoral problems are solved from a technical perspective.

The fundamental need to understand

The basis of a participatory approach is that researchers act with an understanding of livestock-keepers' perspectives, and this research has illustrated clearly the importance of such an understanding in guiding applied research.

The important issue here is that this understanding needs to be about the basis of livelihoods rather than limiting itself to farming systems or livestock systems. A nice example of this emerged through this research when it was realised that 'dairy farmers' in Mwanza in fact prioritised the draught power and manure produced by their cattle above milk, and not surprisingly therefore showed only limited interest in the predetermined dairy research agenda (see table 1 below). However, within this average ranking, there were further

differences, which meant that there were in fact livestock-keepers who considered milk production to be their main objective.

Table 1. *Ranking of the objectives of keeping livestock in the three study locations*

Objective	Location		
	Mwanza (n=26)	Kilimanjaro (n=21)	Morogoro (n=25)
Milk	3	1	1
Meat	Not mentioned	3	4
Manure	2	2	3
Draught power	1	Not mentioned	Not mentioned
Cash income	4	4	2

1 = high

4 = low

n = number of farmers involved in the ranking

Source: Ashley et al (2000).

This latter point illustrates again the importance of understanding difference, and diversity. If we are seeking to address livestock-keepers' real problems, and in particular those of poorer livestock-keepers, then we need to base our research around the diversity and embrace it, not ignore or simplify it. Simply put, any researcher seeking to change livestock-keepers' systems must first understand the systems and the people they would seek to change.

This understanding leads us to challenge the usefulness of the notion of 'smallholder' encapsulated in the title of this project, which now appears to be limited in that it suggests a certain homogeneity which does not in reality exist.

There is little doubt that animal production as a science has not been very good at embracing this diversity, especially in an African context, and again a number of examples of this were raised during this research. One of these emerged through farmer evaluation of existing technologies from the literature which were meant to be potential solutions to their problems. Not only were these options largely rejected by livestock-keepers as inappropriate, but it turned out that livestock-keepers and researchers differed on the very criteria they used to judge these technologies. Farmers were most interested in the money required to implement a strategy, the compatibility with their existing farming system, and the knowledge required. Researchers however tended to emphasise production benefits and benefit-cost ratios, and therefore failed to address the criteria on which livestock-keepers wanted information.

Another example illustrates the weakness of such an approach by researchers. Many years of research on feed strategies has concluded that excess feeding of roughages increases intake and production, and this has become one of the 'facts of life' for many livestock professionals. However this study showed by costing this strategy compared with what farmers were actually doing that if they were to change as recommended by researchers, then they would worsen their position. The reason in this case is that roughage in Kilimanjaro has a cost, and it is therefore expensive to adopt a strategy in which much of the roughage is not consumed.

This example illustrates two concluding points:

- if we accept that there is diversity then we must reject the idea of identifying single or universal solutions to farmers' problems; the best we can do is present 'baskets of options' which are based on farmers problems, but which they can pick and choose depending on their own situation.

- If livestock research is not based on an understanding of the reality of farmers' situations, then all we will continue to do is to conduct research and produce technologies which are of no use to anyone except the relatively wealthy, who are able to accept risk and tolerate failure, and are primarily commercially-oriented. This is a recipe for continued exclusion of the less wealthy.

From science to social science

In some ways this project was an experiment to see what it would take for animal production PhDs to be more farmer focused in their approach, with a wider view of improving the relevance to the poor of animal production research.

In that respect we conclude that such a shift can be achieved and that this project was a positive experience. In fact it is a change which must happen if animal production is to be of relevance to the relatively poor in developing countries. However we found that there were many wider pressures which continually detracted from achieving this objective.

Many of the challenges were related to achieving the kinds of 'reversals' referred to by Chambers (1997), and the differences in norms between animal science research and social science research. Animal scientists working for governments are trained in a particular way, and this tends to emphasise technical issues rather than the wider picture that is important to livestock-keepers themselves. As such they often need to introduce changes to their way of working if they are to be effective participatory researchers. They need to move away from a tendency to simplify and seek averages, towards seeking diversity and disaggregating; they need to stop acting as an extensionist who tells livestock-keepers what they should do and instead acknowledge their own limitations and engage in a mutual learning experience; they need to become familiar with a whole new literature and set of approaches and methods, some of which have a philosophical underpinning which challenge what they consider to be some of the pillars of their own profession and professionalism. But familiarity is not enough – they also need to develop skills in these new approaches so that they can apply them effectively.

None of these observations are new; we already know about them all. The point is that despite this they remain, and they still need to be addressed if seeking to go through the process of reorienting how and why research is conducted in the way this project did.

Research as a compromise

This project serves as an interesting case study of the political economy of conducting research, in which the real determinants of what was done were far from the objective judgements in pursuit of shared goals that we tend to assume gain precedence.

This paper has highlighted how the real issues influencing the direction of the research were in fact more related to different interpretations of the stated objectives of the research in the project document, the need to meet the conditions of a scientific PhD, the budget and time that were available, and the risk-aversion of the research team which led to a reluctance to commit too readily to anything too new in case it compromised the scientific quality of the research.

We have discussed how these multiple influences affected choices of research site, research question, research method and research location, and the nature of the trade-offs between these competing objectives that the project was compelled to make.

As such the research was not fully farmer driven, but represented a compromise between multiple objectives, of which addressing the needs of poor farmers was only one. If it was to be more farmer-focused, then the process followed would need to start one step further back, so that less was predetermined about which subject was to be researched and who was to do it. However this presents challenges if one objective of the research is to contribute to the reorientation of scientific PhD training, and challenges also to the flexibility of research funding.

Challenges for animal science

A number of challenges for the role of animal production in development are posed by this study.

As has been mentioned earlier, the literature search provided little new insight on solutions which were appropriate for the less wealthy livestock-keepers' problems. It is pertinent to ask why this is the case.

There were differences between sites in how this failure to meet livestock-keepers' needs was manifested. In Kilimanjaro and to a lesser extent Morogoro, some options were able to be raised, even though many were felt to be inappropriate by the livestock-keepers. For Mwanza it was difficult to even raise a list of options to discuss, which is one of the reasons why the more detailed research phase of the project did not focus on this area. One of the challenges for animal production specialists is therefore to find a role for the discipline in less intensive systems where maximising animal production is not an objective.

Worse than this lack of relevance of potential animal production technologies, there were several examples when adoption of conventional knowledge about 'good' animal production would have worsened the position of livestock-keepers, indicating that this is out of touch with reality for some livestock-keepers at least.

Finally, many of the more appropriate options presented to farmers indicated a need for more social or policy responses, rather than requiring technical solutions.

In this context, it is reasonable to ask what contribution can animal production research as it is conventionally understood make to addressing the needs of less wealthy smallholder livestock-keepers, and what are the implications of this for how the discipline should respond?

The limits of economics

One of the most interesting findings to emerge from the research concerned the limitations of economic approaches to fully explain livestock-keepers decisions. Several examples emerged where the economics of a particular behaviour suggested farmers should adopt it, whilst farmers themselves were clear that it would not be beneficial to do so. The reason was that the economic criterion was only one of many that they applied when assessing the appropriateness of any change in practice.

These findings emerged when, following the identification of problems, the researchers returned to farmers with suggestions for solutions to these problems, based on financial modelling of technologies from the literature. At first this led to frustration that farmers could not be convinced that the change was good for them – which is itself a familiar position for many animal productionists working with poor livestock-keepers. It was only when the reasons for this reluctance were explained by the livestock-keepers that the limitations of the financial perspective became clear.

Two examples illustrate this point. In the first, the financial analysis of baling strategies suggested that building improved storage sheds would complement this strategy and would pay for itself through the enhanced quality of stored and protected forage. However, the real issue for less-wealthy livestock-keepers was mobilising sufficient funds in advance to pay for the shed, rather than an assessment of potential costs and returns over 10 years, and this was impossible for many without credit.

In the second example a financial analysis suggested that it would be more profitable to replace the ubiquitous use of transported maize stover with concentrates or grass. However, this ignored the fact that concentrates in Kilimanjaro are of unreliable quality and supply, and that dry grass is of only sporadic availability. Hence these two apparently attractive options were not really options at all.

This is particularly of interest because there has been a concerted effort over the last 10 or so years to encourage natural science researchers to pay attention to the economic implications of their research. Experiences in this project suggest that this perspective is itself too limiting. What is in fact needed is for researchers engaged in applied research to locate their research in the wider social, economic, and in fact livelihoods context in which it is intended to be used.

Problems with research and extension

The problems of the research-extension system in Tanzania have been well-documented, following their near-collapse as a result of structural adjustment programmes and funding shortfalls. Nevertheless the findings of this research should make worrying reading on a number of counts.

On the one hand, the research system in Tanzania, and also in the wider global animal production community, does not seem to be producing technologies that livestock-keepers of the kind involved in this study can benefit from.

On the other hand, livestock-keepers were generally not aware of whatever technological options were available to them, because they did not have access to advice on such issues.

This suggests a major 'market failure' in the production of technologies appropriate for poor livestock-keepers, both locally and internationally. This is a worry in a world which is increasingly signing up to the International Development Targets for poverty reduction, and for livestock professionals who would hope to have an influence within this agenda.

However there is little point in even developing appropriate technology if there is no delivery system which is able to make the new technology available to livestock-keepers, as was found to be the case in Kilimanjaro. These dual problems need to be addressed together.

The wider context matters more

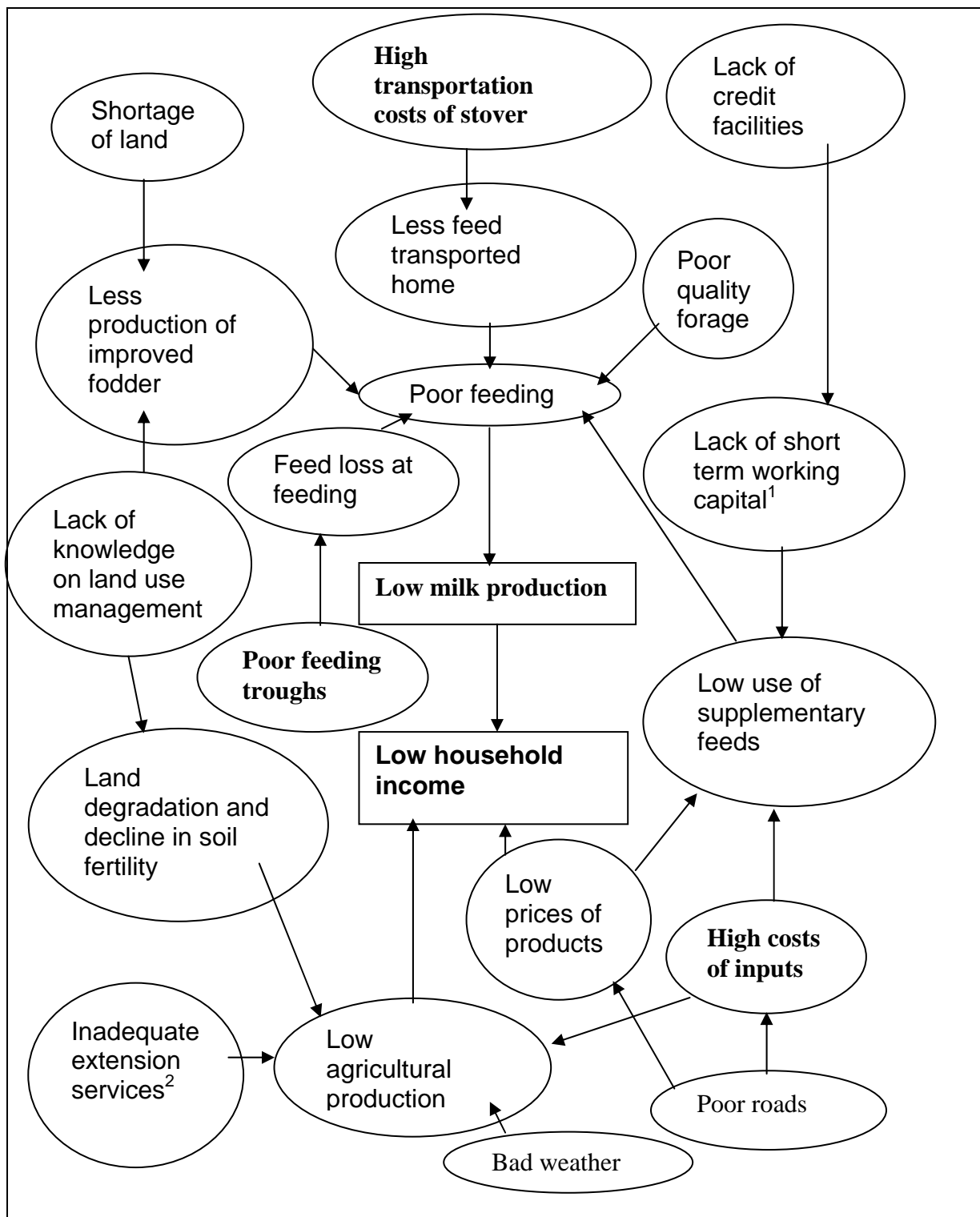
One of the most significant lessons gained from this research relates to the absolute importance of the wider context in which people pursue their livelihoods. Far from needing research and extensionists to provide solutions to their problems, livestock-keepers were often able to suggest the solutions to their own problems. However they could not pursue those solutions because they were frequently out of their control, and for example relied on access to credit which was not an option. Technical solutions were usually therefore not the answer to their problems, which is an important message for researchers and extensionists, as well as for policymakers in Tanzania.

These wider issues were very well described by this research, and are represented for Kilimanjaro in figure 2. This diagram illustrates the importance of issues such as price, credit, infrastructure, education, environment, and extension on livestock-keeping. Most of these are policy issues beyond individual people's control, and have a much greater influence on livelihood outcomes than do technical issues.

An example of this came through a financial modelling of the likely effect of adopting the baling strategy developed by the project, compared with other possible influences. It was calculated (in participatory fashion) that the adoption of manual box baling, and the baling of stripped stover leaves, would lead to an increase of 11% and 22% respectively in enterprise budget, which suggests a well-targeted piece of research with impressive potential impact. This was reflected in livestock-keepers' positive responses to the work.

However, this looked less impressive when it was compared with the effect of a change in milk price received by farmers, as was felt by a team of local and international dairy experts to be possible with interventions in milk marketing (Massawe, 1999). A 25% increase in milk price would lead to an 85% increase in enterprise budget. While researchers concentrate on technical strategies, this suggests that policy level changes, for example related to rural access to markets, may have the potential to achieve much greater gains.

Figure 2. Problem linkage diagram for smallholdings in Kilimanjaro



¹ Working capital included cash required for renting land, paying casual labourers and buying drugs especially acaricides and dewormers.

² Inadequate extension services were generalised as the main cause of low agricultural production, which included both crops and livestock.

Source: Massawe (1999)

5. Conclusions: Implications for Farmer Participation in Livestock Production Research

Ultimately, the project discussed in this paper was successful in its own terms. It succeeded in understanding and describing constraints to livestock-keeping in three parts of Tanzania, it conducted some very interesting technical research which as a result of the participatory process followed was completely different from that which was envisaged at the outset, it contributed to learning for all involved, and it resulted in the first participatory animal production research PhD to be completed at the University of Reading, one of the foremost international centres for animal production.

The objective of this paper has been to show that the experience gained through this project, in addition to the achievements listed above, raises further issues of wider importance to the role of livestock research in the development process. This section considers two main questions arising from this discussion:

1. What does it mean for future animal production research and researchers?
2. What does it mean for animal production as a discipline and its role in poverty-focused development?

In introducing this discussion, we would just like to repeat a caveat made earlier in this paper. We realise that the points being made here are not all new, and that many researchers would no doubt claim that they have overcome many of the problems described here. However, the fact that these issues have been raised all over again during this project, even though we are aware of the problems and possible approaches to dealing with them, suggests that there are still wider issues here to confront.

The institutional² environment for research

Does the discussion in this paper mean that livestock research should increasingly become farmer focused and adopt participatory approaches? The simple answer to this question is yes, since it appears that livestock production research to date in Tanzania and elsewhere has had little effect on relatively poor livestock-keepers, but would also not have done so even if the extension system was effective, because of the lack of appropriate technologies for the resource poor which are 'on the shelf'.

However there are a wider set of issues at play which mean that this question is in practice rather more difficult to answer.

The first is a rehearsal of the argument of what is research for: to push forward the frontiers of science or to develop applied technologies which are able to contribute to poverty reduction and national economic growth? Clearly, both of these are required. Are these two objectives compatible? If not, then researchers, and the factors which cause researchers to investigate the subjects they do, need to be clear which of these needs they aim to address. This choice has implications for where the research question comes from: a farmer focused approach bases the research question on issues of practical relevance to farmers; a 'pure' science approach bases the research question on recent developments in the scientific literature which may have no relevance at all to the needs of poor livestock-keepers.

² The word 'institutions' is used here, as in the new institutional economics, to mean the 'rules of the game', rather than 'organisations'.

To recap on the approach followed in this project, the process of understanding livestock-keepers' constraints led to the identification of a need for solutions to the problem of costly crop residues. The baling research findings conducted as a result of this analysis were not in themselves scientifically impressive, but they were appropriate and relevant to a pressing need felt by farmers. Thus the project contributed to the development process by addressing livestock-keepers' needs. However, it could not be said that the research rolled back the scientific boundaries.

This has implications for future research strategies. For example, would a Tanzanian animal scientist seeking to excel and develop an international reputation in his/her field consider the research of the kind conducted in this project to contribute to this objective? Will the major animal science journals publish this kind of work? Is this kind of work therefore valued by the animal science discipline internationally?

Certainly the concerns felt by some of the research team about the implications of some of the decisions to make the research more farmer focused were very much related to these kinds of questions. The prime concern was not at all whether the directions taken were sensible – everyone agreed that this was a desirable process to pursue. The concerns were all about whether this would contain sufficient 'science' to merit an animal production PhD from Reading. In the end this proved not to be a problem, but would this always be the case?

The paper discussed how many of the prime concerns of milk-producing livestock-keepers were not related to technical animal production issues, but reflected a much broader range of technical disciplines, and also were frequently not technical at all. This introduces a danger for any researcher engaged in a process of participatory research that the researchable issues emerging from the process would either not be suitable for technical research, or would not be 'animal production' issues. How should they respond in this situation? What are the universities' and journals' positions on this? What would Reading University or a leading animal production journal, for example, consider to be an animal production issue, and more importantly what would it consider not to be an animal production issue?

The answer to these questions at present is a resounding 'don't know'. However, the seriousness of the discussion on choice of research topic which pervaded this project suggests that a positive answer is not a foregone conclusion.

What this discussion suggests is that the incentives which drive academic animal production research are currently ambiguous on whether they support or do not support farmer focused participatory approaches. Whilst this remains the case, there is always a risk of being judged negatively, and this risk is borne by individuals who would pursue such approaches. If participatory approaches are to become more widespread amongst animal productionists working in poor countries – as this project suggests is needed – then the discipline needs to create the formal and informal rules which encourage such approaches. Currently, such rules cannot be seen to be in place. Until this happens, each researcher who has a wider academic interest but who adopts a participatory approach will be taking a personal risk, which is a powerful incentive not to bother.

If the findings of this study and the discussions held while it was being implemented reflect the wider picture of animal production, then we can conclude that academic animal production has largely failed to apply itself to the needs of poor livestock-keepers. It is not surprising then that there is an apparent lack of appropriate technology to help the poor maximise the contribution of livestock to their wider livelihood objectives.

Animal production and development

The clear conclusion to be reached from this paper is that if we are seeking to meet the needs of less wealthy farmers through livestock research, then we must ensure our research is based on a good understanding of their realities. One method for achieving this is through socially-informed farmer participatory research. But these ideas have been around for a very long time within the development world, at least since 1983 when Chambers published his first book on 'putting the last first'. Why has it taken so long for livestock professionals to begin to take notice of them?

Morton (2000) attributes the lack of participatory livestock research to difficulties of working with livestock on farms, plus also some global factors related to small researcher populations and, unlike for crops, the lack of dramatic contributions from the international livestock research centres made early on.

This conclusion undoubtedly provides a partial explanation. However, an alternative explanation is possibly more serious – that animal production as a discipline is itself challenged by working with 'resource poor' livestock-keepers and is unclear how to respond.

Specifically, the discipline is premised on increasing animal production, but in the context of a progressive global shift towards interest in small-scale livestock keepers and particularly the poor, the question is 'production of what?'. In working with commercial profit maximising livestock producers to increase market supplies of animal products the discipline has been effective. However it has become apparent that this approach has frequently neglected other types of livestock-keepers.

This research shows that poor people not only have multiple rather than single and focused objectives, but also that the combinations of objectives and their relative priorities differ between people. Simple notions of production as often pursued by animal productionists are therefore first often not economically viable, but more seriously are frequently not even in line with what poor livestock-keepers are trying to achieve.

We may return to the question of why this research project showed that there were few appropriate technological solutions to the livestock-keeping problems of the poor. If this weakness is more widespread than the limited focus of this study alone and is to be addressed, there would appear to be a need to think through what an appropriate role might be for animal production research in working with the poor, and then to think through what changes might be needed to ensure this role can be fulfilled.

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Annex 1: Methods used and reasons

Activity	Reason
PRELIMINARY ACTIVITIES	
Preliminary discussions with key informants, consultation of available literature and brief visits to villages to find out about the general context of milk production, producers and marketing	<ul style="list-style-type: none"> to learn as much as possible about the context of the work, and the extent of similar systems, to feed into considerations of applicability of findings, and to obtain ideas for research planning
Discussions with key informants about criteria for village selection, and preliminary selection	<ul style="list-style-type: none"> to define selection criteria and gain suggestions about possible villages which fulfil those criteria
Visiting potential villages	<ul style="list-style-type: none"> to have general discussions with village key informants and visit different parts of the village so as to ascertain whether the villages fulfil selection criteria, and to gain an understanding of broad livestock systems, milk production, feeding practices, and constraints.
Visits to other villages	<ul style="list-style-type: none"> to widen our experience of variations to be found in different areas, and the range of constraints faced
VILLAGE MEETING: general	
Initial meeting using PRA exercises with a group of key informants from village Farmer Research Groups	<ul style="list-style-type: none"> to gain an overview of livelihoods and livestock issues in the selected village
Ranking objectives of livestock keeping	<ul style="list-style-type: none"> to see how important milk production and sale is amongst the products and services provided by livestock
Rank livestock constraints	<ul style="list-style-type: none"> to see how important livestock feeding constraints are when compared with other livestock problems
Resource mapping	<ul style="list-style-type: none"> to gain an overview of the village, and to provide an opportunity to discuss grazing patterns (including who takes them, where, when, for how long etc), resource availability, characteristics of different hamlets and many other issues
Feed inventory	<ul style="list-style-type: none"> to see the full range of feeds used by livestock
Feed matrix scoring	<ul style="list-style-type: none"> to assess perceptions of characteristics of the various feeds identified through the feed inventory
Feed seasonality	<p>to understand the seasonality patterns by which feeds (including grazing) are:</p> <ul style="list-style-type: none"> available used stored processed
Other seasonalities	<p>to see how other factors vary over time, and how they may interact with feeding to provide opportunities or impose constraints, including:</p> <ul style="list-style-type: none"> rainfall – good/bad labour use - women, men, children, including probing on peak and least labour times milk production animal production events - breeding, calving/kidding, disease, mortalities cash availability types of purchases food availability

	<ul style="list-style-type: none"> prices of milk, labour, fodders etc for economic calculations
VILLAGE MEETING: milk producers/ processors/ sellers	
Rank importance of different incomes	<ul style="list-style-type: none"> to assess how important milk income is compared to other incomes
Feed seasonality and other seasonalities	<ul style="list-style-type: none"> as above
Constraint identification	<ul style="list-style-type: none"> to undergo a process of analysis with respondents to elicit feed constraints, their causes, effects, possible solutions, and researchable issues
Wealth ranking	<ul style="list-style-type: none"> to gain an understanding of the differences between households according to wealth, the factors that determine wealth, and characteristics of different wealth groups
Research planning matrix	<ul style="list-style-type: none"> to investigate differences in priority attached to different research possibilities according to wealth rank
Ranking of constraints and solutions	<ul style="list-style-type: none"> to improve the process by which constraints are analysed and possible solutions are considered
Gender division of labour	<ul style="list-style-type: none"> to identify the various tasks involved with keeping livestock, who does them, when they occur, and how difficult they are